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Cover photo: Mechanized pruning at Red Hills Vineyard in Creston, CA. (Photo by Dave Coronel)

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"To stimulate continuing improvement in the wine industry."

Relationship between tannin concentration, variety, quality, and consumer preferences

BY P. A. Smith, M. D. Mercurio, R. G. Dambergs, I. L. Francis, M. J. Herderich, Australian Wine Research Institute, Glen Osmond, SA, Australia

Why measure tannins? At the most fundamental level, measuring tannins helps to understand the composition of the grapes and wines. Among researchers and winemakers, it is speculated that tannin measures could be used to help target grape and wine quality specifications.

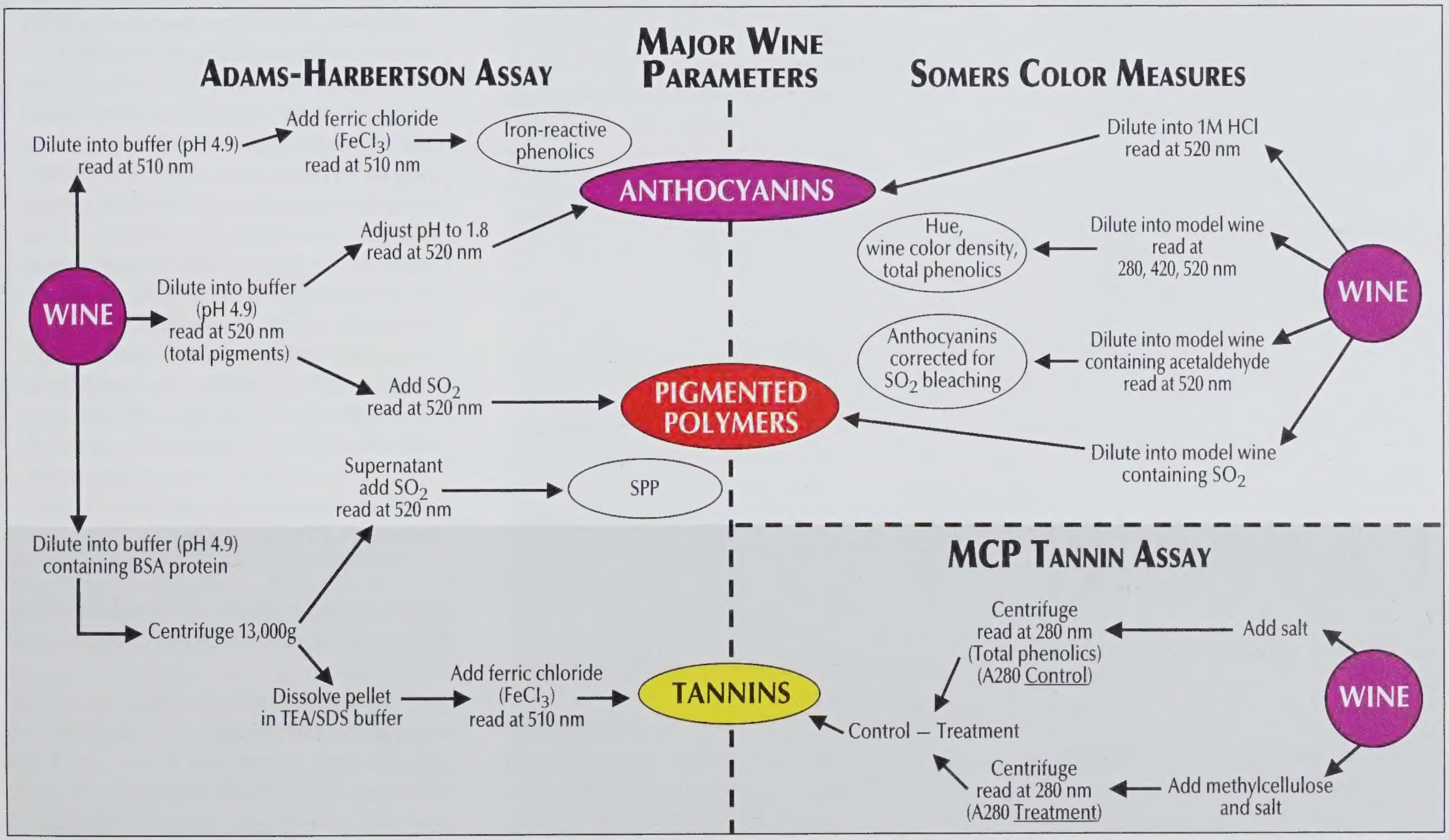
Red wine tannins may be closely correlated to red wine quality. Composition parameters crucial to characterizing red grapes and wines include pH, acidity, sugar, anthocyanin, and tannin concentration.

Established procedures are widely used to measure the pH, acidity, color, and sugar content of grapes and wine. However, while numerous methods for determining tannin concentration are documented in the literature, no comprehensive data are available to determine and benchmark the tannin concentration of grapes or wine.[1]

Since grape phenolic composition and the extraction of tannins during vinification critically influence the astringency and color attributes of red wine, such routine tannin measures may improve the ability to grade grapes based on their tannin concentration and to tailor the tannin concentration of red wine to a particular style.

A grape grower may benefit from measuring tannins through the whole growing cycle, but particularly near harvest, by gaining a better understanding of how minimal rainfall/irrigation influences tannin concentrations in the grapes and the implications of long hang time for fruit maturity.

A winemaker may obtain a more objective measure of the influence of modified pump-over methods or


ADAMS-HARBERTSON ASSAY
MAJOR WINE PARAMETERS
SOMERS COLOR MEASURES
Dilute into buffer (pH 4.9) read at 510 nm
Add ferric chloride ($FeCl_3$) read at 510 nm
Iron-reactive phenolics
ANTHOCYANINS
Dilute into 1M HCl read at 520 nm
Adjust pH to 1.8 read at 520 nm
Hue, wine color density, total phenolics
Dilute into model wine read at 280, 420, 520 nm
WINE
Dilute into buffer (pH 4.9) read at 520 nm (total pigments)
WINE
Anthocyanins corrected for SO_2 bleaching
Dilute into model wine containing acetaldehyde read at 520 nm
Add SO_2 read at 520 nm
PIGMENTED POLYMERS
Dilute into model wine containing SO_2
Supernatant add SO_2 read at 520 nm
SPP
Dilute into buffer (pH 4.9) containing BSA protein
MCP TANNIN ASSAY
Centrifuge 13,000g
Centrifuge read at 280 nm (Total phenolics) (A280 Control)
Add salt
Dissolve pellet in TEA/SDS buffer
Add ferric chloride ($FeCl_3$) read at 510 nm
TANNINS
Control – Treatment
WINE
Centrifuge read at 280 nm (A280 Treatment)
Add methylcellulose and salt

Flow chart comparing the steps needed to measure color and tannin using the Adams-Harbertson assay, Somers Color Measure, and MCP tannin assay.

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numerous other processing variables on the tannin concentration and color of their wines.

A marketer may gain a better understanding of the taste preferences of the Asian market with regard to astringency. However, all of these benefits require the ability to measure tannin first.

Tannin concentration can be measured easily

Precipitation-based analytical methods are generally considered to be the most practical methods for tannin determination in a winery. Although other acceptable precipitation-based assays exist,[5,6,7] two specific methods that are gaining favor in Australia and the U.S. are summarized here.

One is based on precipitation of tannin by a protein (the Adams-Harbertson or A-H assay) and the second is based on precipitation of tannin by a polysaccharide (the methylcellulose precipitable or MCP tannin assay).

Figure A and Table I provide a summary for these assays. In their fundamental form (to measure only tannin), these methods are based on two steps, where Step 1 is essentially a "precipitation" step to separate tannin from all other phenolics and Step 2 involves measurement of the sample to determine the concentration of precipitated material. Generally coupled with these assays is an additional metric designed to provide information on color.

In Australia, the MCP assay is currently being rigorously evaluated to determine its full utility within the wine industry. A summary of this work follows. The AWRI now has methods for rapid measurement of grape and wine tannin by spectral prediction, using predictive models. This significantly increases the speed and simplicity with which tannins can be measured.

Australian survey of tannin in grapes and wines

Once the ability for measuring tannin was achieved, grape growers and winemakers needed to understand the variation and magnitude of tannin concentration in red grapes and wine. A review of published results from tannin surveys showed that limited sample numbers have been studied so far.

Protein Precipitation Assay summary

For the Adams-Harbertson assay,[4] the principal steps are:

STEP 1:

Precipitation — This step uses Bovine Serum Albumen (BSA) protein to precipitate the tannin out of grape extract or red wine. Essentially the tannin and the protein become tangled (or "complexed") and insoluble and the tannin-protein "complex" separates from the liquid as a solid precipitate.

STEP 2:

Tannin — This precipitate is then redissolved in a separate solution and an iron-containing reagent is added, which reacts with specific groups in the tannin, called "ortho-dihydroxy phenols" (ODPs). When iron (Fe3+) and the ODPs react, a color change occurs that is used as a measure of the amount of tannin precipitated from solution.

Color – Another part of the A-H assay can be used for measuring colored phenolic compounds in grapes and wine. In wine, the non-bleachable compounds are measured in a similar way to the red-color colorimetric Somers assay, which is popular in Australia. However, non-bleachable pigmented material that **is** precipitable with protein is differentiated from non-bleachable pigmented material that is **not** precipitable with protein. The results of A-H color analysis give the amount of monomeric pigments (anthocyanins), small polymeric pigments (SPPs), and large polymeric pigments (LPPs) in a wine.

To improve our knowledge of tannin concentration in Australian grapes and wines we have used the efficient HTP (high throughput) format to undertake a comprehensive survey.

Methylcellulose Precipitation Assay

For the methylcellulose precipitable (MCP) tannin assay,[2] the principal steps are:

STEP 1:

Precipitation — This assay involves a "precipitation" step that uses methylcellulose (MC) instead of a protein.[2] The tannin and the methylcellulose become tangled and, after addition of ammonium sulfate, become insoluble, and the tannin-MC complex separates from the liquid as a solid precipitate. Otherwise, the precipitation step is similar to that in the A-H assay.

STEP 2:

Tannin — Before and after precipitation of the tannin, the amount of polyphenols in solution is measured spectrally with a UV/Vis spectrophotometer and the difference equates to the amount of tannin. This method does not use a secondary reaction with another reagent.

Color — The Iland color measurement method for grapes (Iland et al, 2000) and the Somers color measurement method for wine (Somers and Evans, 1977) in conjunction with the MCP tannin give a full color and tannin measurement suite. For grapes, the same extract used for color measurement can also be used for tannin measurement. A standard operating protocol for performing the assay is available at www.crcv.com.au/resources/ and the Australian Wine Research Institute (AWRI) Analytical Service offers this assay.

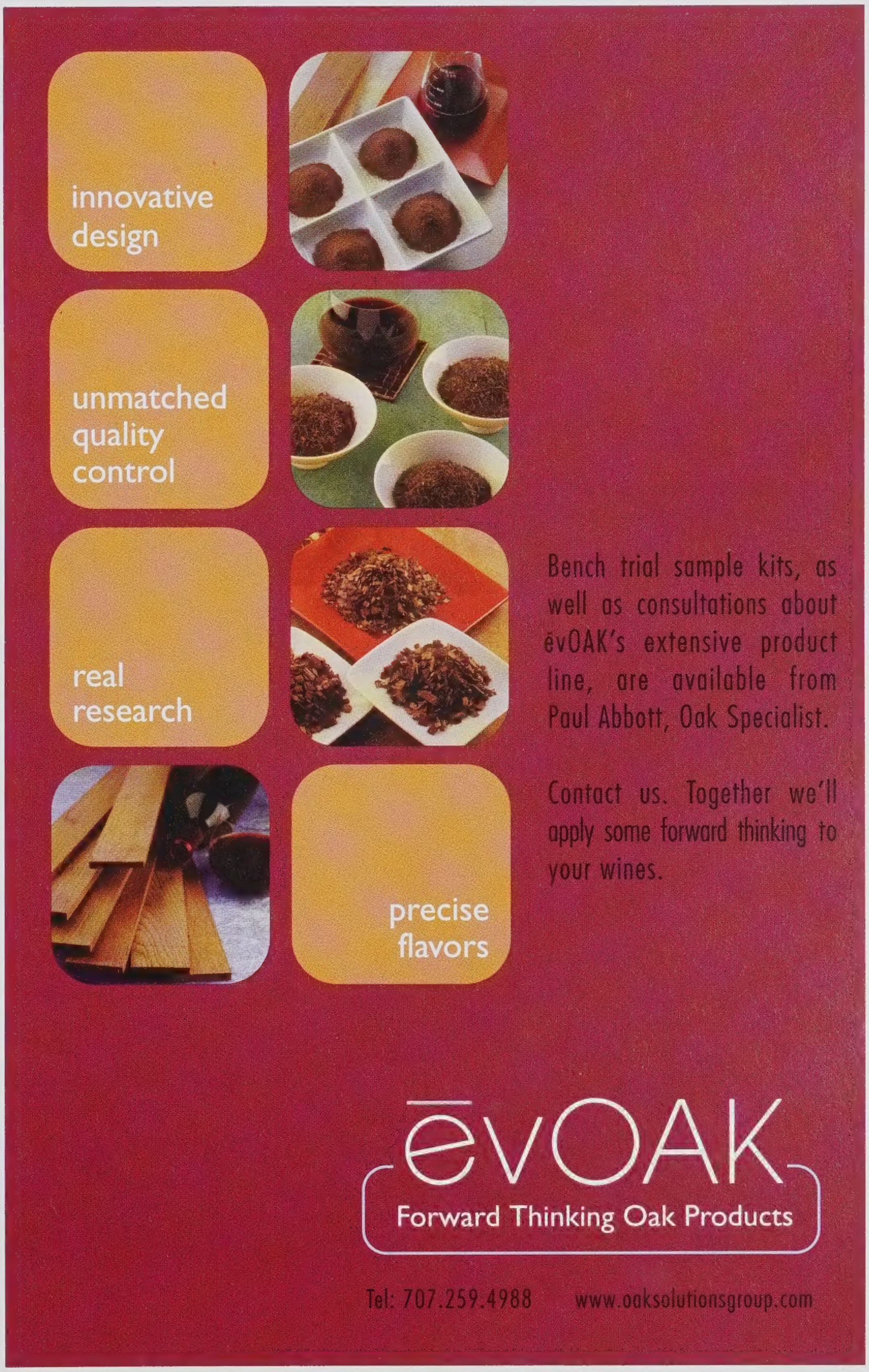
We are continuing development of the reference database through analysis of grape extracts (almost 600 samples) and wines (almost 1,200 samples). Results from this survey allow for benchmarking and classification of low, medium, and high tannin concentration categories for Cabernet Sauvignon, Shiraz, Pinot Noir, and Merlot wines.

Figure II highlights the distribution and categories for these varieties. Grape variety affects average tannin concentration, though regional differences and other variables result in a moderate overlap of concentrations among varieties.

Vintage can affect tannin concentration

If we consider the average tannin concentrations for the last five vintages (2003–2007) of Shiraz and Cabernet Sauvignon wines included in our survey, it appears that there is also a variation with vintage.

For example, Figure III indicates that there appears to be a steady increase in the average wine tannin concentration from 2004 to 2007 for both Cabernet



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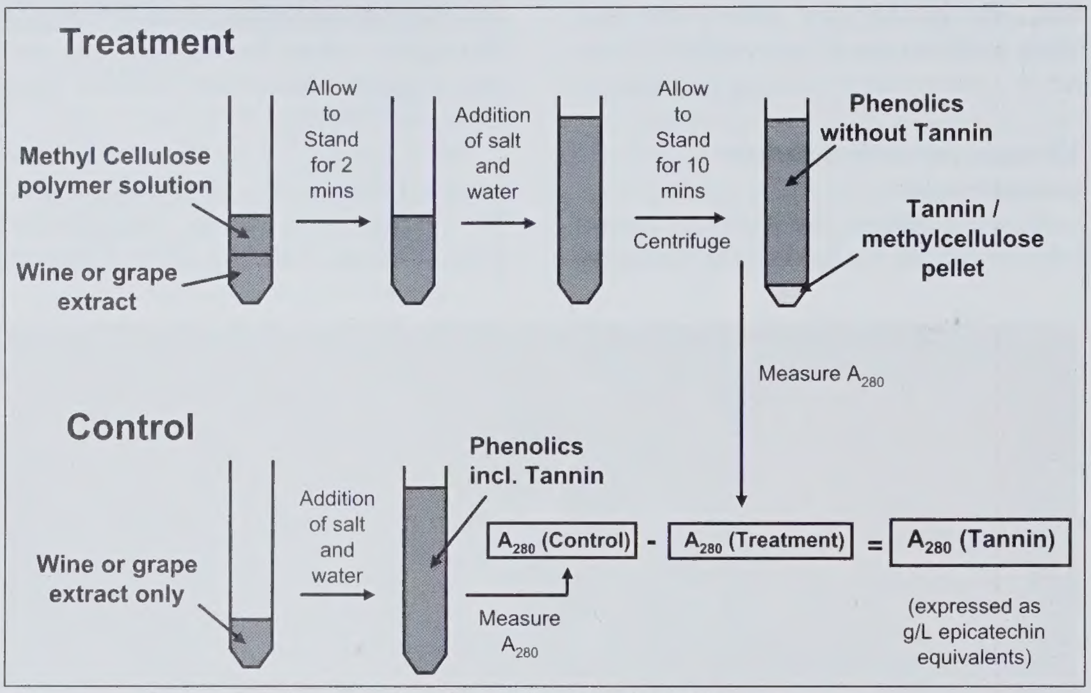

Treatment
Methyl Cellulose polymer solution
Wine or grape extract
Allow to Stand for 2 mins
Addition of salt and water
Allow to Stand for 10 mins
Centrifuge
Phenolics without Tannin
Tannin / methylcellulose pellet
Measure A_{280}
Control
Wine or grape extract only
Addition of salt and water
Phenolics incl. Tannin
Measure A_{280}
A_{280} (Control) - A_{280} (Treatment) = A_{280} (Tannin)
(expressed as g/L epicatechin equivalents)

Figure I: A schematic of the procedure for performing the MCP tannin assay.

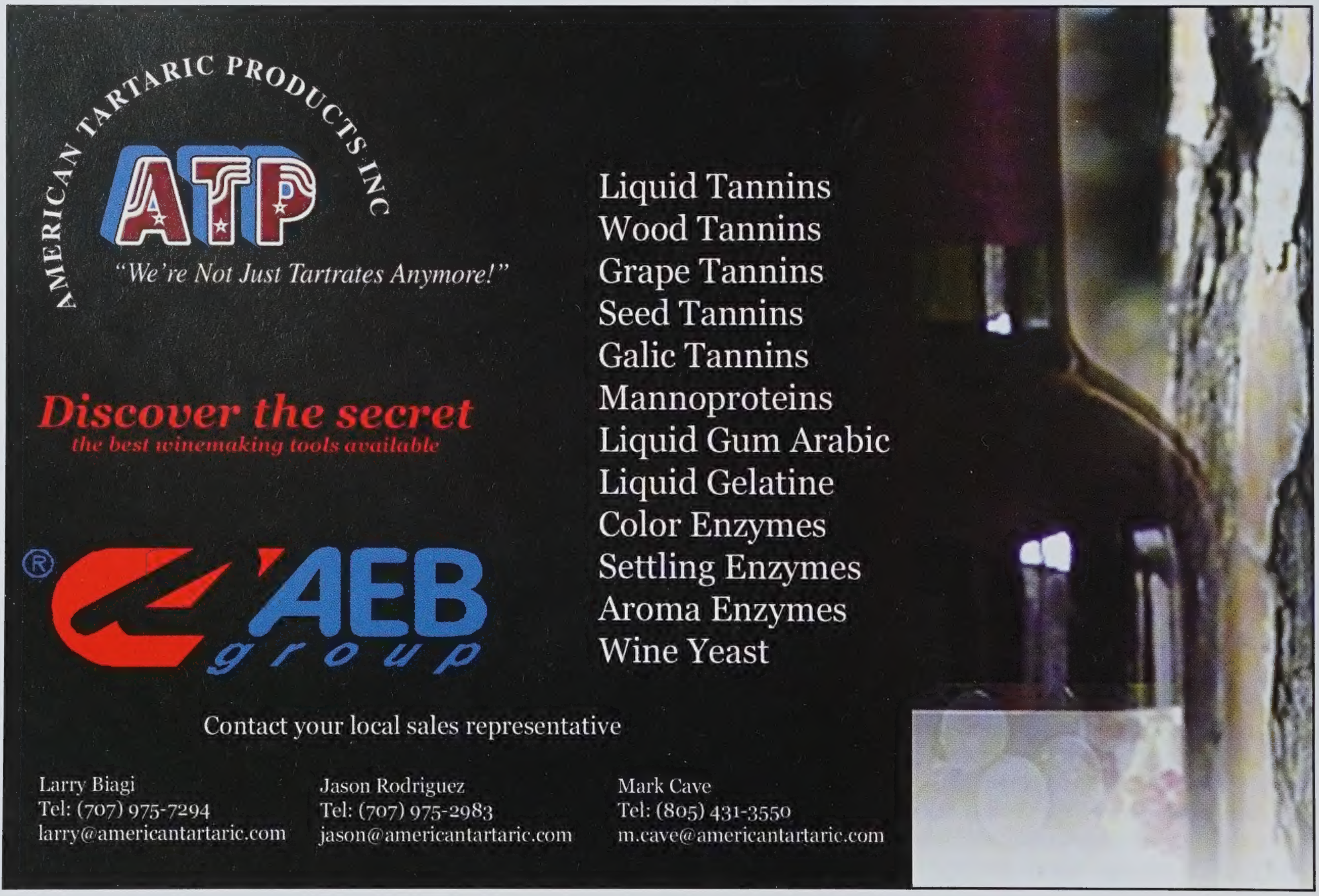
Sauvignon and Shiraz. This provides objective evidence that vintage can affect tannin concentration and that the trend can be similar for different varieties.

Region affects tannin concentration

The survey also highlights the magnitude of the differences in wine tannin concentration that can occur from region to region.

Tannin concentration of red grapes and wines has quality implications

The relationship between red wine quality and red wine tannin concentration was investigated by relating tannin concentration to quality grades as assessed by commercial allocation tasting within a major Australian wine company in 2006. A strong, positive correlation was shown between wine quality and wine tannin — the higher the quality, the higher the tannin concentration. For red wines, a similar trend appears across three wine companies. One set of data for 2004–2006 samples is shown in Figure V.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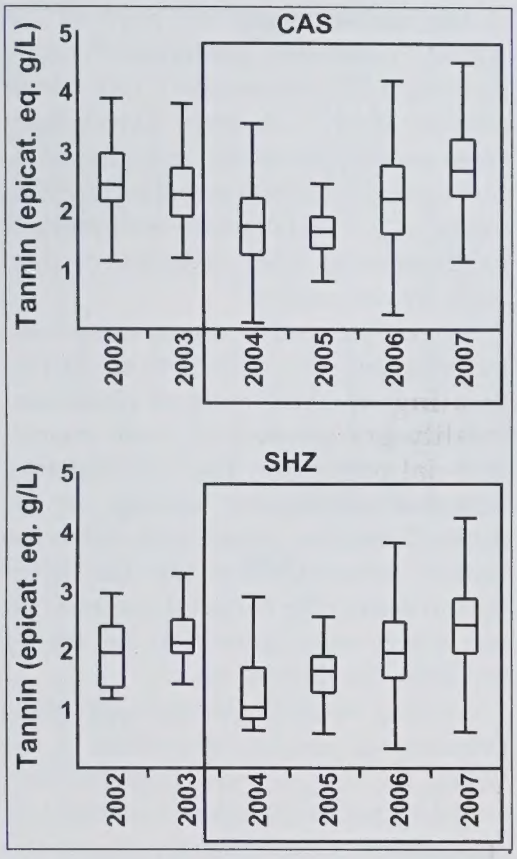

Figure III: The average tannin concentrations for the last five vintages of Shiraz and Cabernet Sauvignon wines included in our survey. It highlights the variation with vintage and the steady increase in the average wine tannin concentration from 2004 to 2007.

Tannin influences sensory aspects and consumer wine preference

Tannin concentration has been shown by numerous authors to be positively correlated to sensory panel ratings of astringency. An area of keen interest is the development of techniques to predict astringency.

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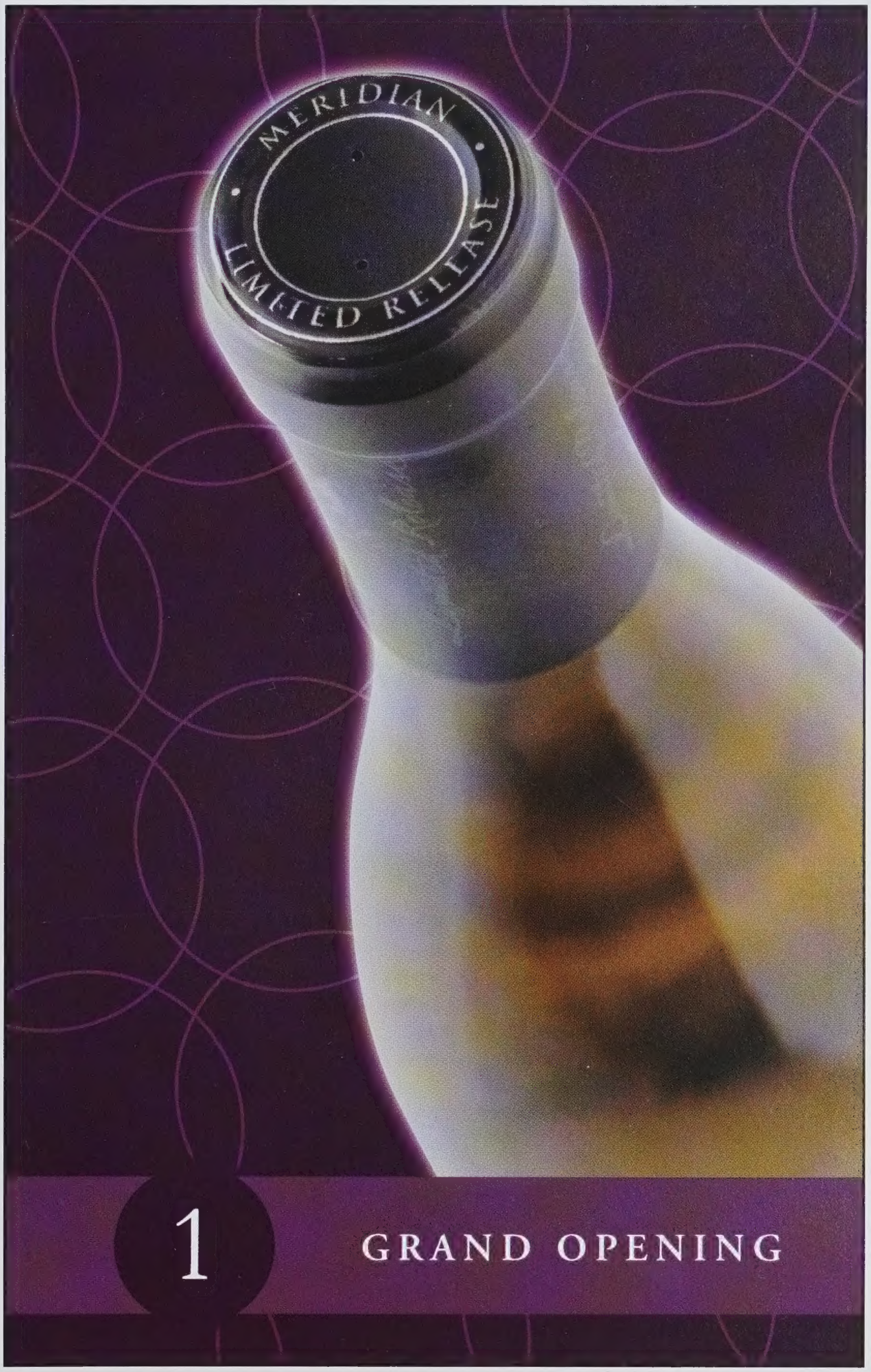
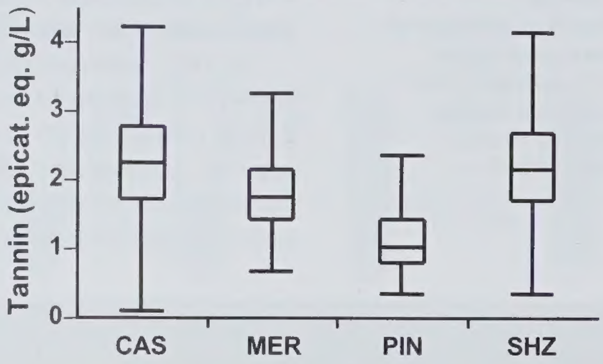




Variety	N	Low	Med	High	Mean
CAS	629	0.1 – 1.7 g/L	1.7 – 2.8 g/L	2.8 – 5.3 g/L	2.9 g/L
MER	188	0.3 - 1.4 g/L	1.4 – 2.2 g/L	2.2 – 3.3 g/L	1.8 g/L
PIN	112	0.4 – 0.8 g/L	0.8 – 1.4 g/L	1.4 – 3.5 g/L	1.2 g/L
SHZ	1107	0.4 – 1.7 g/L	1.7 – 2.7 g/L	2.7 – 4.9 g/L	2.2 g/L

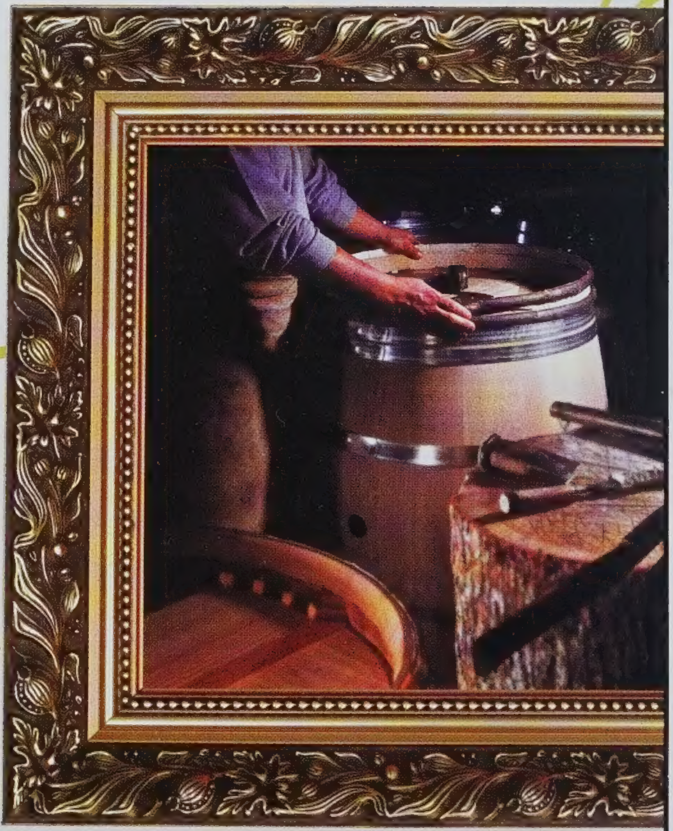
Figure II: The classification of low, medium and high tannin concentration categories for Cabernet Sauvignon, Shiraz, Pinot Noir, and Merlot wines from the AWRI tannin survey of Australian wines.

Such model systems might allow prescreening of wines for studies or give an indication of wine astringency without the need for costly and time-intensive sensory studies.

We collaborated as part of an AWRI "consumer preference" study in which 20 commercial red wines (Shiraz and Cabernet Sauvignon) were carefully selected as representative examples of the major wine types made in Australia and were assessed to determine how well-liked they were by consumers.[3]

In addition, the wines were subjected to sensory descriptive analysis by a trained AWRI sensory panel and the sensory properties were quantified in triplicate. The relationship between astringency ratings of the trained sensory panel and red wine tannin concentration (by the MCP tannin assay) for these 20 commercial red wines was shown to be strong (r^2=0.85). See Figure VI.

Having established and quantified the range of sensory properties of the wines, the next step was to assess how well a subset of the wines was liked by consumers. Cluster analysis on the



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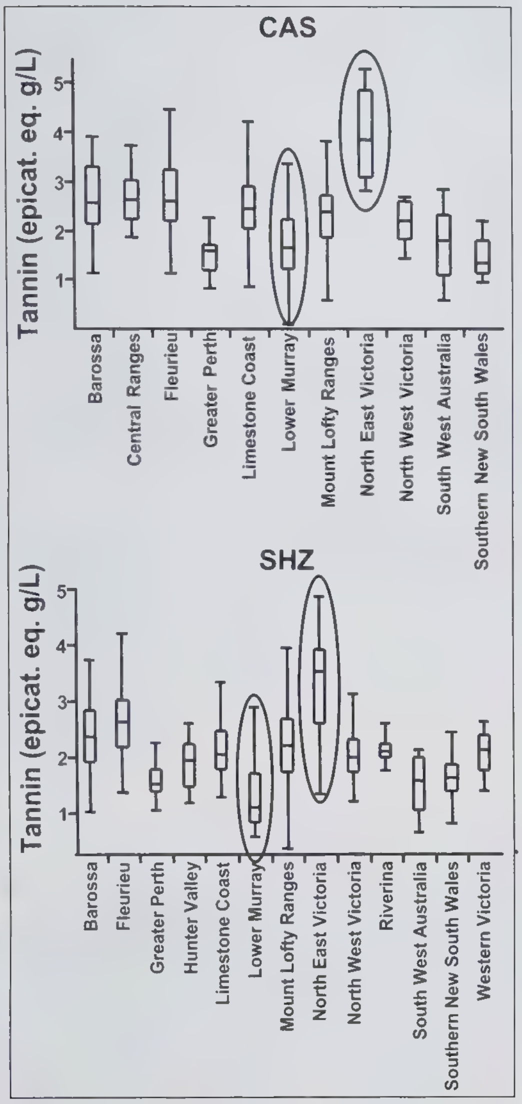

Figure IV: Tannin concentrations for a number of Australian regions, with regions having the highest and lowest average tannin concentration circled.

consumer data showed that consumers could be grouped into segments who behaved similarly, generally liking and disliking the same wines. Four distinct clusters comprised varying proportions of consumers, with the largest cluster (cluster-4) including 45% of the consumers (90 people).

The relationship between astringency (drying) ratings for a trained sensory panel and the "liking" scores of a consumer cluster (45% of the consumers) indicate that wines with intermediate tannin concentrations, or a "tannin sweet spot" between 1.3 and 1.9 g/L, were most liked by these consumers. This is highlighted in Figure VII, where the MCP tannin concentrations are shown next to each wine.

Work such as this helps to address questions such as, "What do consumers think about astringency in wines?" or "What level of astringency is liked or disliked?" and "Is there a concentration of tannin consumers prefer in red wines?"

Summary

These relationships demonstrate that tannin measurements such as MCP tannin can assist with decisions regarding quality assessment, product specifications, and vineyard and winery management procedures; they can also complement sensory assessment related to consumer preferences and astringency. Such improved definition of composition and style might also allow exploration of

Table I: Factors for selecting a standard tannin and color measurement method

Adams-Harbertson Assay	MCP Tannin Assay
Measures both tannin and color (color measurement steps can be skipped).	Measures tannin and total phenolics.
Protein is added to precipitate tannin.	Polysaccharides are added to precipitate tannin.
Five reagents are necessary for assay.	Two reagents are necessary for assay.
No UV required; visible-only spectrophotometer can be used.	Requires a spectrophotometer that measures in the UV.
Vortex mixer is required.	No vortex mixer is required.
Requires more steps and longer incubation times.	Requires a control for each sample (more sample preparation).
Centrifuge required.	Centrifuge required.
	Color can be measured with Somers Assay.
	Reagents are non-toxic with easy disposal.

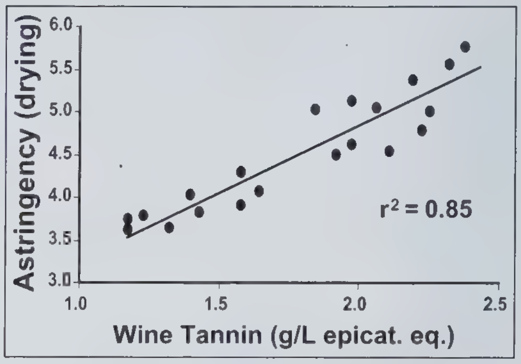

Figure VI: The positive relationship between astringency and tannin (as measured by MCP tannin assay) shows that the assay mimics human perception of astringency.

tannin measures for the development of product specifications.

In this context, note that sensory expectations of consumers, particularly in emerging markets, might well be different from the views of researchers, winemakers, and experienced wine enthusiasts. Therefore, it is important to continue to unravel the compounds responsible for wine flavor and mouthfeel, and also to increase the understanding of consumer preference.

The MCP tannin assay can be easily implemented in a basic laboratory or samples can be sent to the AWRI Analytical Service for analysis.

The AWRI grape and wine tannin survey will continue. Interested wine industry personnel are encouraged to consider measuring tannin for themselves, in both grapes and wines, as part of a suite of approaches to allow them to better understand their products.

Any interested parties are invited to approach the AWRI for assistance in

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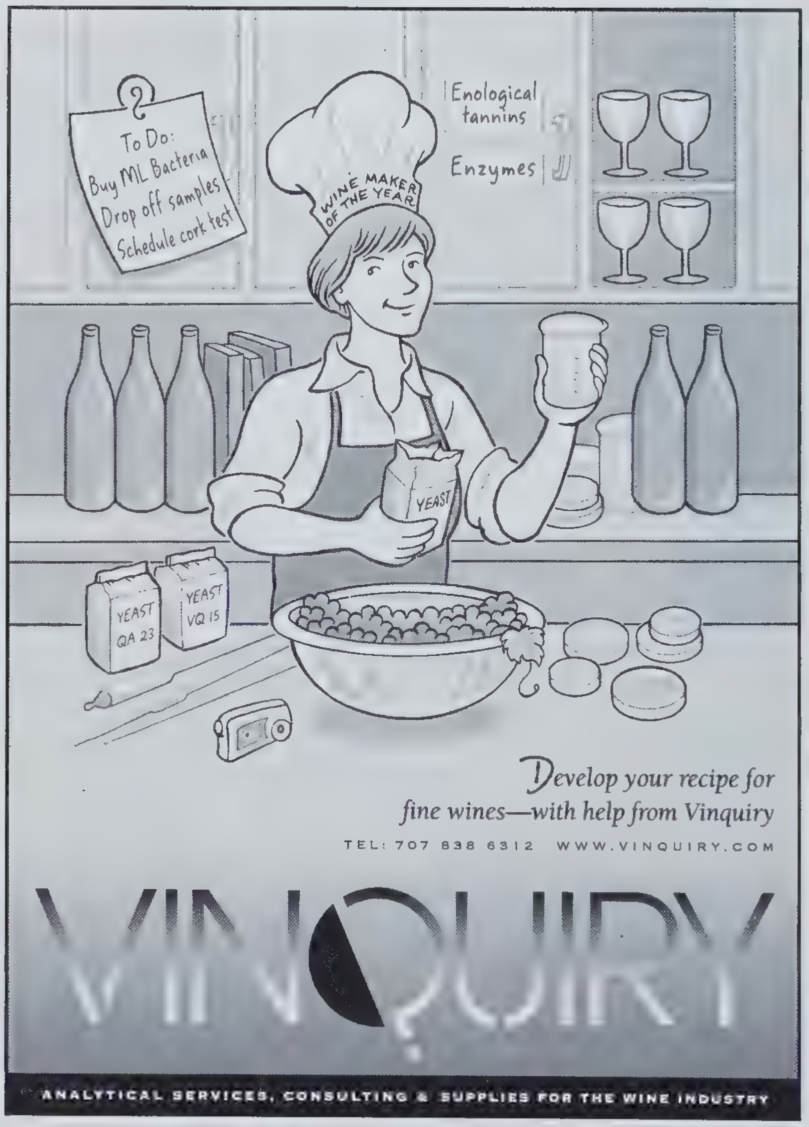
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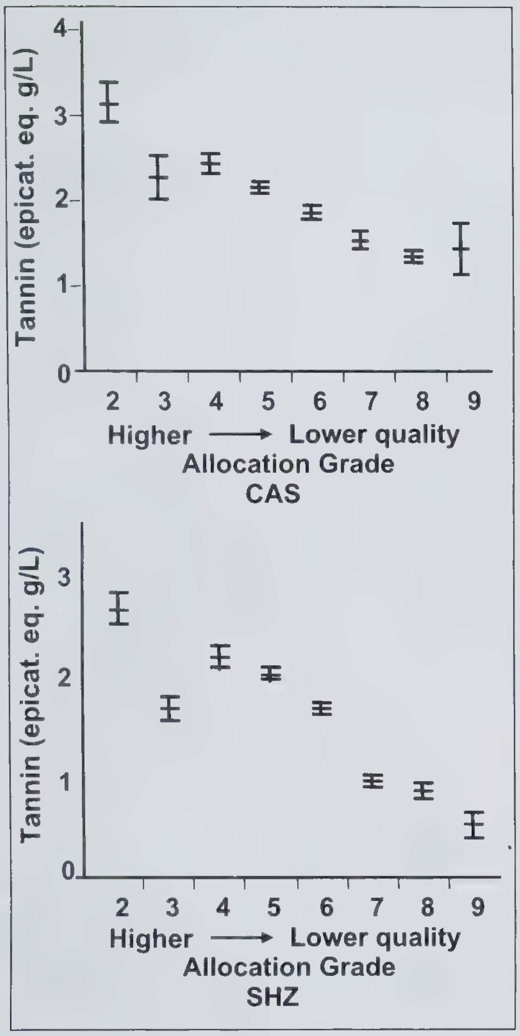

Figure V: The relationship between red wine quality and red wine tannin concentration was investigated by relating tannin concentration to quality grades as assessed by commercial allocation tasting within a major Australian wine company – the higher the quality, the higher the tannin concentration.

any aspect of implementation and tannin research in general. Adding tannin measurements to the existing protocols for grape and wine analysis will certainly be a step toward better understanding of the important role tannins play throughout the production of quality wine. ■

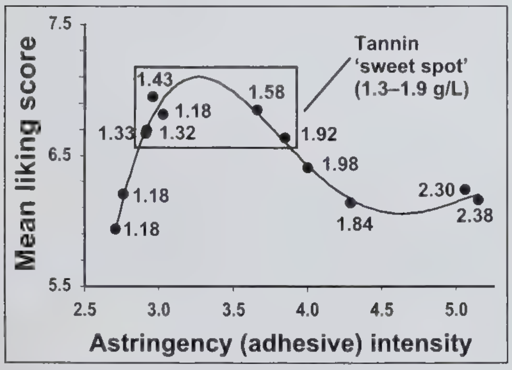

Figure VII: The relationship between astringency (drying) ratings for a trained sensory panel and the 'liking' scores of a consumer cluster (45% of the consumers).

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FUTURE OF THE WINE INDUSTRY
Climate Change Science

**BY Kimberly Nicholas Cahill,
Christopher B. Field
Stanford University and
Carnegie Institution for Science
Stanford, CA
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Climate is clearly important to the viability and success of the wine industry worldwide. A map of the world's winegrowing regions shows that large-scale cultivation of grapevines happens in particular places and not others. We know that these places share certain climatic features, such as winters without killing freezes and generally moderate summer temperatures.

Growers and connoisseurs around the world are familiar with generalizations about both climate and winegrowing (for example, you can expect about 110 days from bloom to harvest) and specifics about certain regions or grape varieties (for example, warm Rutherford is well-suited to producing high-quality Cabernet Sauvignon, while Pinot Noir thrives in cooler Carneros).

What, then, warrants all the recent attention to the issue of global climate change, including several articles in *PWV*? (Robinson, May/June 2007; Jones, July/August 2007; Smart, January/February 2005.)

Aren't growers accustomed to dealing with changes in weather conditions as part of their everyday job? How can we know what the climate is going to be like in the future, when weather forecasts are famously fickle? How is it possible that humans could be affecting something as vast as the climate system of the entire planet?

These are frequent questions from those in the wine industry, who have reason to view climate change as a huge-scale and far-off subject, when they have pressing issues with their own operations on the ground. This article attempts to answer some questions that growers and winemakers must address as they try to understand and evaluate the application of climate science to winegrowing.

WHAT IS CLIMATE? At any location, the daily, seasonal, and annual patterns of temperature, precipitation, wind, and humidity characterize the weather. A weather forecast is useful to address questions like, "Should I bring an umbrella tomorrow?"

Climate is the statistical summary of weather over 10 to 30 years. In addition to average properties, climate covers questions such as, "How many days over 100°F are there in a typical growing season? What's the difference between January and July likely to look like here? What grape varieties are likely to do well here, based on where they thrive in other parts of the world?"

WHAT DRIVES THE EARTH'S CLIMATE? Essentially, the temperature of the Earth is controlled by the balance between input from the sun (some of which our eyes can see as visible light) and reflection and heat radiation from the ground. Clouds, ice, and snow reflect much of the energy from the sun. Land and water absorb most of the high-energy, short-wavelength energy from the sun, and then emit longer-wavelength energy as heat, with hotter surfaces emitting more.

This heat energy can't be seen with our eyes, unless assisted by thermal imaging technology such as night-vision binoculars. The heat energy is released in the direction of space, but heat-trapping or "greenhouse" gases such as carbon dioxide (CO_2) in the Earth's atmosphere naturally absorb or trap some of it and radiate it back toward Earth, raising the temperature the way a radiator warms a room. This "natural greenhouse effect" is a good thing for life on Earth. Without the atmosphere, the average temperature of the planet would be a frigid −18°C (0°F), instead of the actual average of 15°C (59°F).[22]

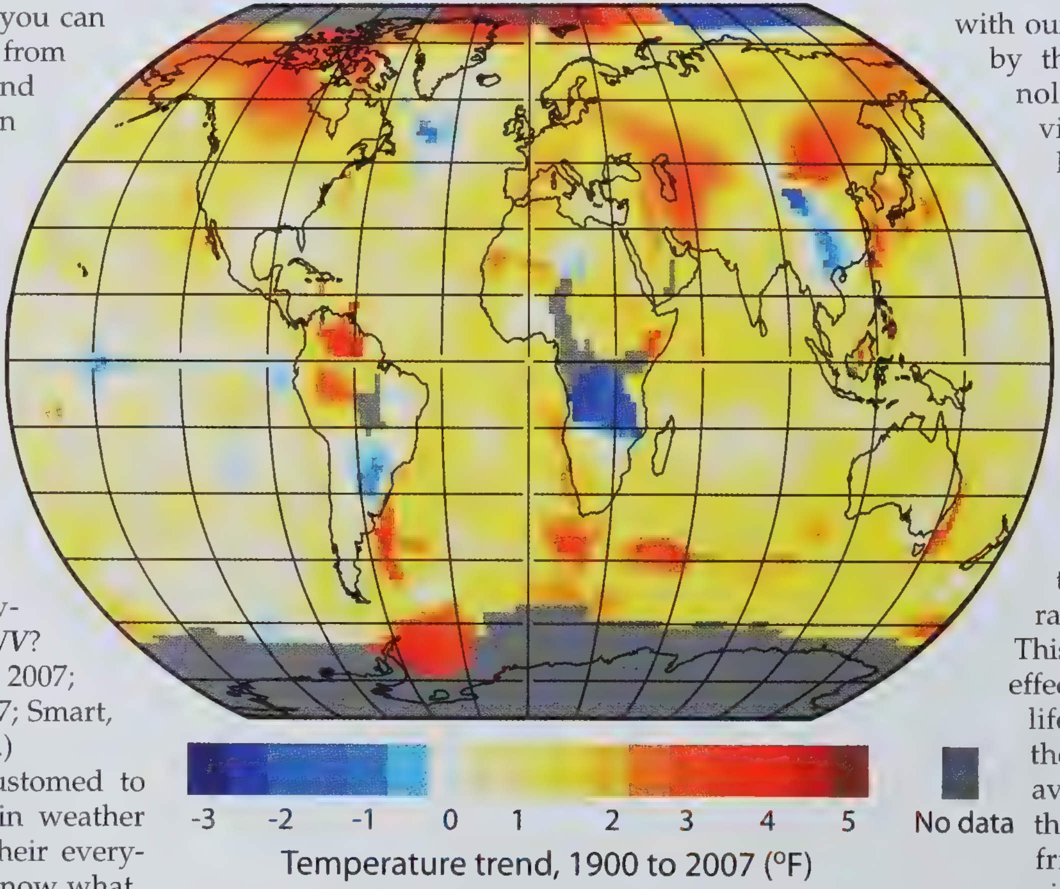

Figure II. Historical temperature trends observed over the earth. Note that warming (darker red colors) has been observed over nearly all continents.

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WHAT CAUSES CLIMATE CHANGE? Over the billions of years of Earth's history, it has experienced a wide range of natural climate changes. Over the last million years, a dominant driver has been subtle fluctuations in the shape of Earth's orbit, which have resulted in a cyclical progression of ice ages. The last ice age ended about 18,000 years ago.

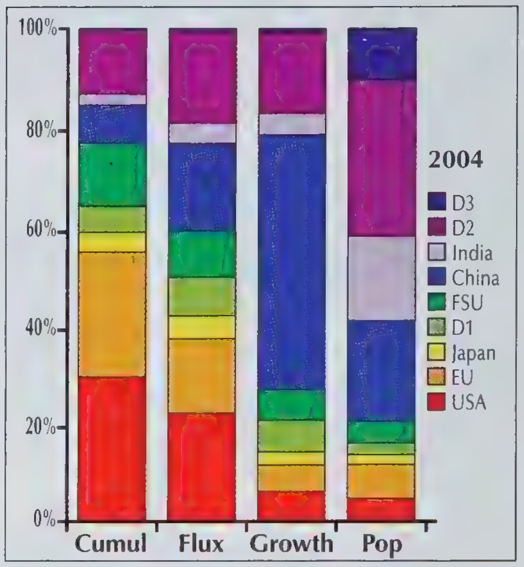

Figure I. Relative contributions of greenhouse gases in the atmosphere from nine regions (EU = European Union; D1 = other developed countries such as Canada; FSU = Former Soviet Union; D2 = developing countries such as Brazil and Mexico; D3 = least developed countries, such as most of sub-Saharan Africa). Cumul = cumulative emissions since the start of the industrial revolution to 2004; flux = average emissions from 2000–2004; growth = five-year growth rate in emissions from 2000 to 2004; Pop = current population.

Since the Industrial Revolution, however, human activity has become a global-scale "force of nature," especially by adding greenhouse gases to the atmosphere faster than they can be removed by natural processes. This "enhanced greenhouse effect" is increasing the temperature of the atmosphere, much as pulling on a second blanket on a cool night absorbs more of the heat from your body and radiates it back to you.

The role of greenhouse gases in affecting the earth's climate has been understood for a long time. A Swedish scientist, Svante Arrhenius, published a paper in 1896 demonstrating that CO_2 from burning coal could warm the atmosphere.[1] He used very simple calculations to show that increasing the concentration of atmospheric CO_2 by 2 to 2.5 times could cause a warming of 3.4°C (6.1°F), a number close to the middle of the current range of projections (see "What are the projections for the future?"). The accuracy of this calculation is partly a result of lucky assumptions, but it is also partly a demonstration of the relatively simple nature of the basic physics of the greenhouse effect.

We have records of the amount of CO_2 in the atmosphere over the last 600,000 years. Atmospheric CO_2 has been carefully and continuously measured at Mauna Loa, Hawaii since

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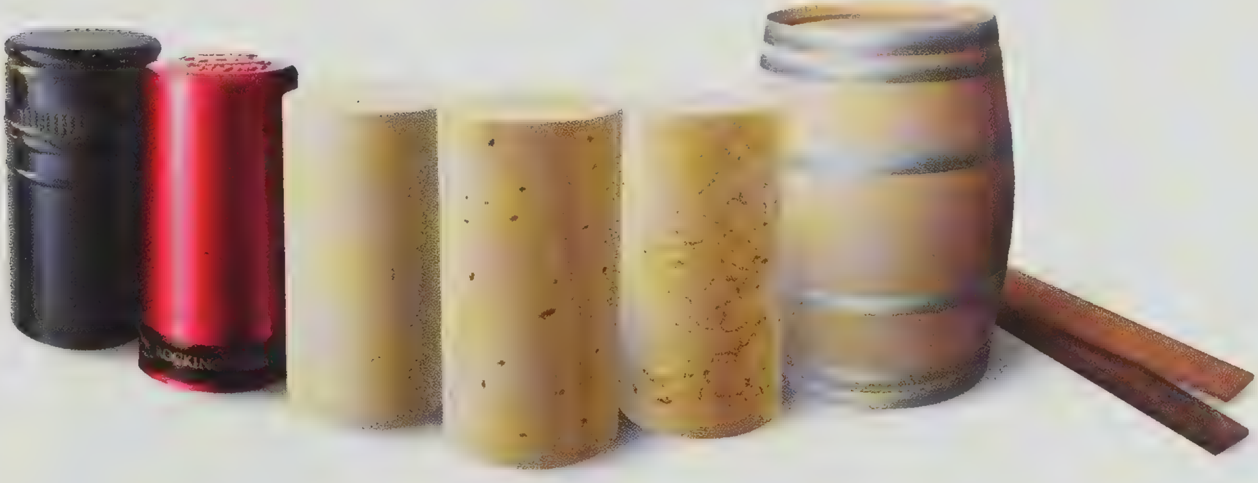

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1957. Before 1957, we can infer atmospheric CO_2 from bubbles of air trapped in continental ice sheets on Greenland and Antarctica.

Before the Industrial Revolution, CO_2 levels in the atmosphere were around 285 parts per million (ppm). When the Mauna Loa measurements began, the levels were around 315 ppm. Today they are over 380 ppm, a 33% increase over pre-industrial levels, and they are increasing about 2 ppm per year.[16] There is no doubt that the increase in atmospheric CO_2 since the start of the Industrial Revolution is due to human activities.

Where does this human-induced CO_2 come from? In the early decades of the 20th century, most of the CO_2 from human activities came from the clearing of forests. Today, more than 80% of it comes from the burning of fossil fuels like coal, gasoline, and natural gas.[7] These fuels contain carbon from decayed plants that have been buried in the earth for millions of years, and are now being burned so rapidly that it has overwhelmed the processes that naturally remove atmospheric CO_2.

The geographical origin of emissions is also changing. About 80% of CO_2 from burning fossil fuels, to date, has come from industrialized countries (with only 20% of the world's population), while the remaining 80% of the population have contributed only 20% of the emissions.[16] Since 2000, however, about 70% of the increase in emissions has come from developing countries. (Figure I).[16]

Carbon dioxide is not the only greenhouse gas related to human activity. Methane (CH_4, released from industry and agriculture), nitrous oxide (N_2O, released mainly from agriculture), low-atmosphere ozone (O_3, a by-product of smog), and several industrial chemicals related to air conditioning and refrigeration together account for about 80% as much greenhouse warming as CO_2.

Water vapor is also a greenhouse gas, but its concentration in the atmosphere is not subject to direct human influence. The amount of water vapor in the atmosphere is controlled by the temperature, because the capacity to hold water vapor increases with rising temperature. Thus, water vapor acts as an amplifier, boosting the warming effects of other greenhouse gases.

HOW DO WE KNOW THAT CLIMATE CHANGE IS REALLY HAPPENING? Imagine getting your winery's Board of Directors or management team to read a document summarizing the highly technical and complex details of your operations, and their significance to your bottom line. Now imagine them going through an explicit and lengthy process to agree to EVERY SINGLE WORD in the document. This is the process used by the

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panel convened by the world's governments to assess knowledge about climate change (the Intergovernmental Panel on Climate Change, or IPCC; www.ipcc.ch/) about once every six years.

The cumulative contributions of this international team of expert scientists, including four major assessments and many special reports, earned them a share of the Nobel Peace Prize in 2007. IPCC scientists read and interpret the vast published literature on climate change and write a comprehensive, balanced portrayal of the current scientific understanding.

Drafts are reviewed by experts inside and outside the world's governments, and independent editors assure that the authors provide comprehensive responses to all reviews. Final approval is by consensus among representatives of the world's governments (about 120 for the 2007 reports), including word-by-word approval for the Summary for Policymakers. The IPCC reports represent the gold standard of scientific credibility (and as such, are rather conservative).

IPCC reports in 2007 make it clear that climate has warmed in recent decades and that human actions are a primary driver of most of the warming. In the words of the IPCC:

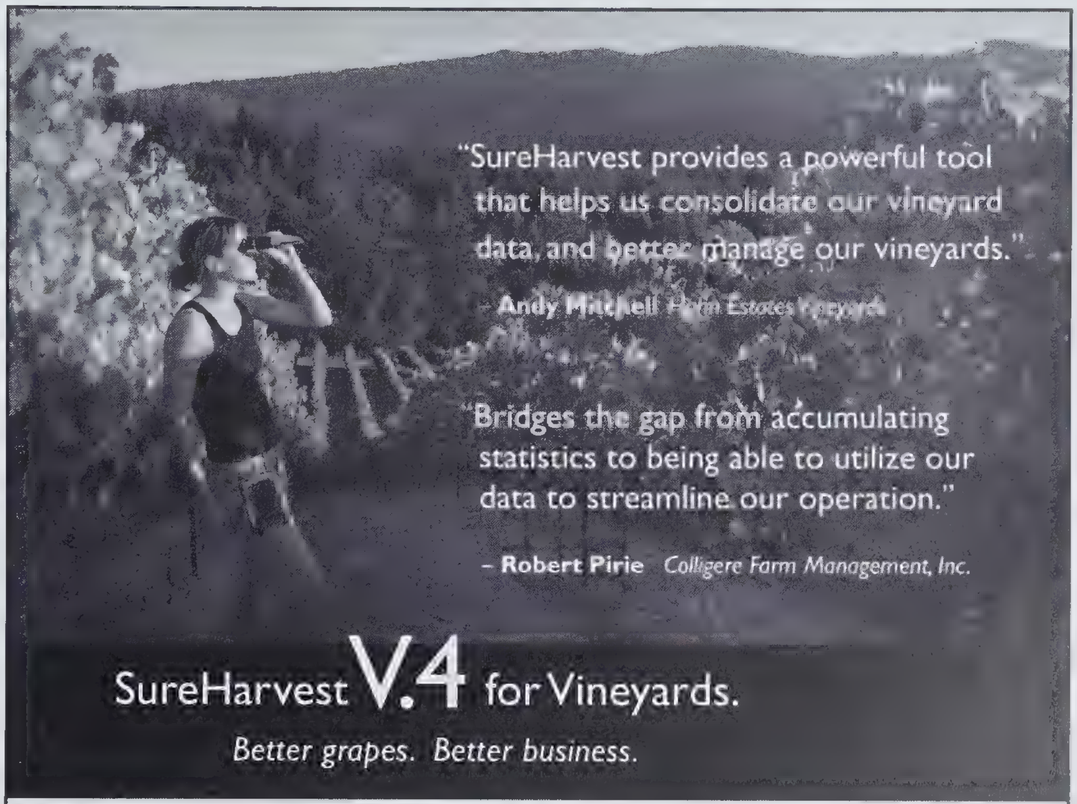
"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level."[7]

"Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic [human-caused] greenhouse gas concentrations."[7]

During the 20th century, the global mean temperature increased by 0.74°C (1.3°F). Most of the globe warmed, and only limited areas have experienced cooling, mostly over oceans (Figure II). The rate of warming has been very rapid in the last few decades. Globally, 11 of the last 12 years are in the warmest 12 years of the last 150 years, since the beginning of the record based on accurate thermometers.[7]

Impacts of the climate changes that have already occurred are also clear. Mountain glaciers are shrinking worldwide. Summer disappearance of Arctic sea ice is reaching record levels. An increasing fraction of tropical storms is reaching a very damaging level of intensity.[7]

In North America, sea levels have risen in most coastal regions, contributing to increased coastal flooding. Over the last 50 years, the frost-free season in the western U.S. has lengthened by several days per decade, resulting in increased risk of wildfires. Warmer temperatures in the western U.S. have



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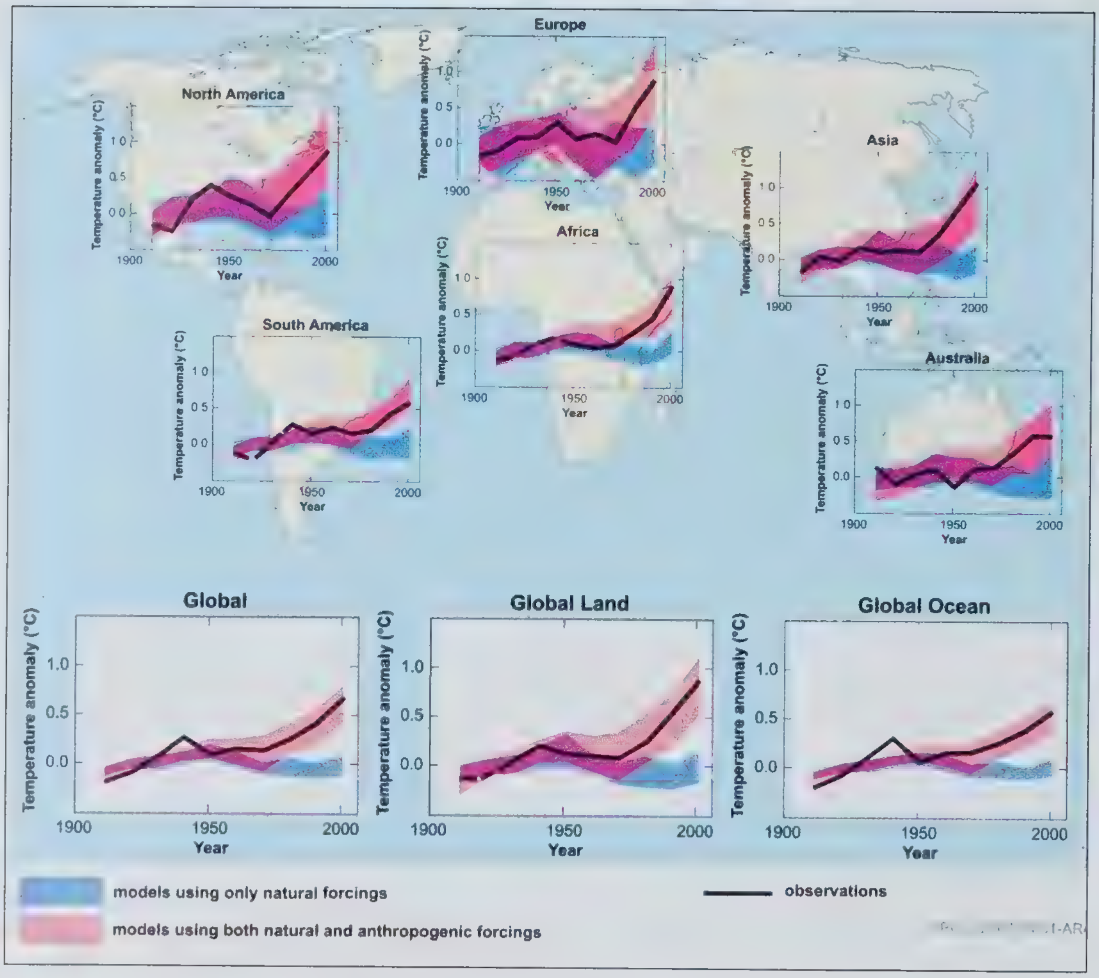


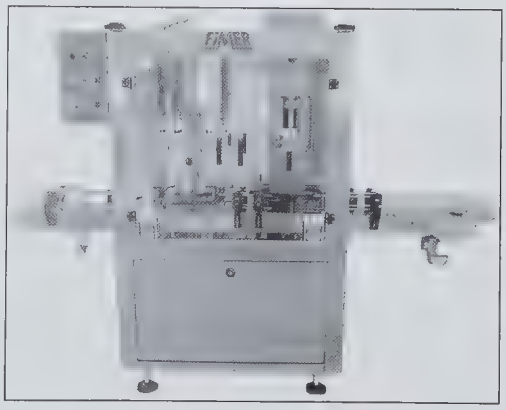
Figure III. Observed surface temperatures over continents and the globe from 1906–2005 (black line), compared with results simulated by climate models using only natural inputs of solar activity and volcanoes (blue band; standard deviation around annual average for five climate models, 19 simulations) and models using both natural and human inputs (pink band; standard deviation around annual average for 14 climate models, 58 simulations).

led to decreased spring snowpack and distribution shifts of many plants and animals toward the cooler parts of their ranges.[6]

HOW DO WE KNOW THAT PEOPLE ARE REALLY CHANGING THE CLIMATE, AND NOT NATURAL CYCLES? In a study examining 928 peer-reviewed scientific papers from 1993–2003, N. Oreskes found that not a single paper disagreed with the consensus position that human activity is the cause of the recent and currently occurring climate change.[14]

Observations and climate models both point to the role of human activities in causing recent climate changes. Some observational evidence is indirect. For example, it is clear from measurements that changes in the output of energy from the sun are not large enough to explain the observed warming.

Other evidence involves direct observation of "fingerprints," specific elements of the changes that are consistent with human contributions to climate change, but not with other mechanisms. The best fingerprint example is the observed high-atmosphere cooling, an observation expected with warming from greenhouse gases but not from other mechanisms.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The current trends of human greenhouse gas emissions were first recognized as "the great geophysical experiment" 50 years ago,[17] but it is an ***uncontrolled*** experiment. There is no convenient "control" planet otherwise similar to Earth that we can leave alone while we are changing the composition of our atmosphere. As a consequence, scientists use climate models, complex computer programs that simulate the three-dimensional movements and thermodynamics of the atmosphere and oceans.

Under development for more than 50 years, the modern generation of models is based on well-understood physics and tested against a large array of observations. While the models are far from perfect, they effectively represent a wide range of features of past and current climate.

When these models are run with only natural contributions driving climate (blue bands in Figure III), the projected global and regional temperatures do not warm over the 20th century, in contrast to the observations (black line in Figure III). But when the models are run with both human and natural contributions, projected temperatures (pink bands in Figure III) and observed temperatures (black lines in Figure III) agree closely.

HOW CAN WE PREDICT WHAT WILL HAPPEN FAR IN THE FUTURE? DIDN'T SCIENTISTS USED TO TALK ABOUT GLOBAL COOLING? All climate models substantially agree about the warming trend currently under-

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way, and project continued and accelerated warming in the future.

All of the approximately 20 major climate models share similar representations of the main forces driving the atmosphere and oceans. They differ in subtle but important details concerning things like the statistical properties of clouds, which are important for determining how much of the sun's energy is reflected back into space before the earth has a chance to absorb it. Most of the ongoing research and discussion on climate models concerns these details.

Climate model projections of global cooling from nearly 40 years ago were also based on a human-caused phenomenon: very small particles (aerosols) from smokestacks and farming causing a cooling effect by reflecting some sunlight back to space.[15]

Climate models have improved in the last 40 years, but the most important reason that the global-cooling scenario did not occur is that emissions of the cooling pollutants decreased (especially through deliberate investments to improve air quality), while the emissions of greenhouse gases have continued to increase exponentially. Aerosols from smokestacks do have a net cooling effect, which has been acting to reduce the warming experienced from greenhouse gases.

The current estimate is that the direct and indirect cooling effects from aerosols may offset about 40% of the warming effect of the main greenhouse gases related to human activity.[7]

WHAT ARE THE PROJECTIONS FOR THE FUTURE? Economic and political decisions about energy and resource use in the coming years will be critical for determining the amount of greenhouse gases emitted. This, in turn, will drive the temperature changes we experience: more emissions will result in greater and more potential damage to the climate change.

Because of inertia in the climate system, we are committed to some warming in the future, even if all greenhouse pollution was stopped today. Experts estimate this locked-in warming from greenhouse gases already in the atmosphere to be between 0.2°C–1°C (0.35°F–1.8°F) (yellow line in Figure IV).[21] However, this amount of locked-in warming is small compared to the range of warming driven by current and future human emissions.

The range of emissions considered by the IPCC entails a warming more than 66% likely to fall within the range of +1.1° to 2.8°C (2.0° to 5.0°F) under a lower greenhouse gas emissions scenario, and 2.4° to 6.2°C (4.3° to 11.2°F) under a high emissions scenario. The group's "best estimate" of likely global warming is between +1.6° to 4°C (+3.2° and 7.2°F) by 2100 (Figure IV).[7]

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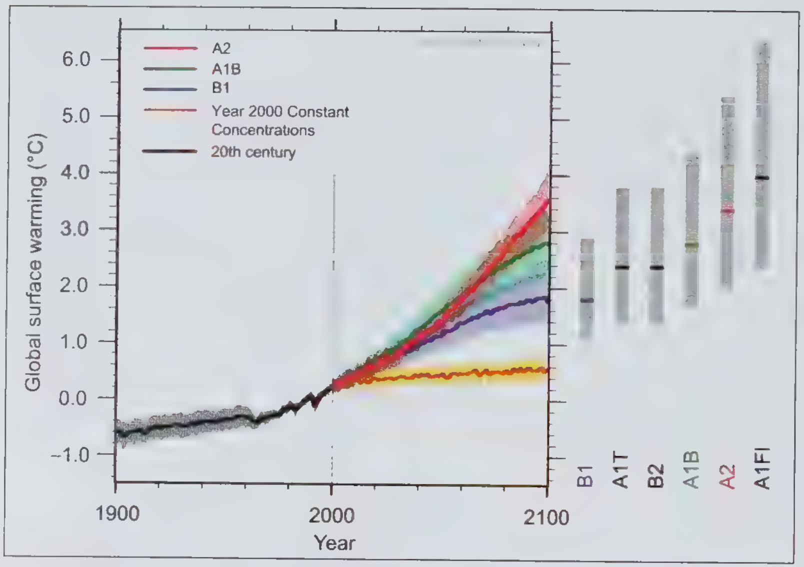

Figure IV. Projected warming in global annual average temperatures from multiple climate models for a range of scenarios of emissions of greenhouse gases. Yellow line represents a case where no further greenhouse gases were added to the atmosphere. Gray bars to the right represent the range of 66% probability, with solid lines within each bar representing the IPCC "best estimate." Colored shading represents ±1 standard deviation.

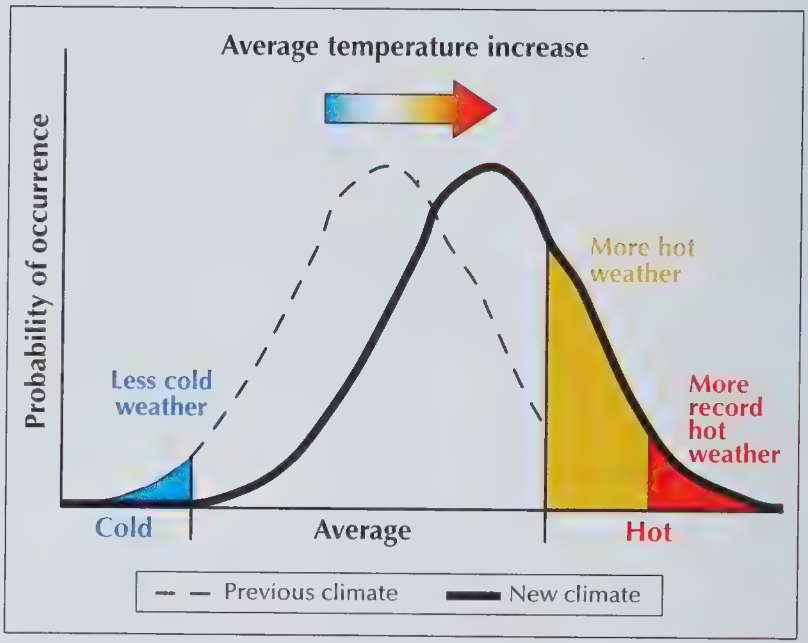

Figure V. Probability distribution of average temperatures under baseline climate (broken line) and a warmer climate (solid line). Even a small shift towards warmer average temperatures leads to greater incidence of hot weather and record hot weather.

In California, the projected annual average temperature increases for the state over the next century are between approximately +1.7° and 3.0°C (3.0° to 5.5°F) for a lower emissions scenario, and 4.4° to +5.8°C (+7.9° to 10.4°F) for a

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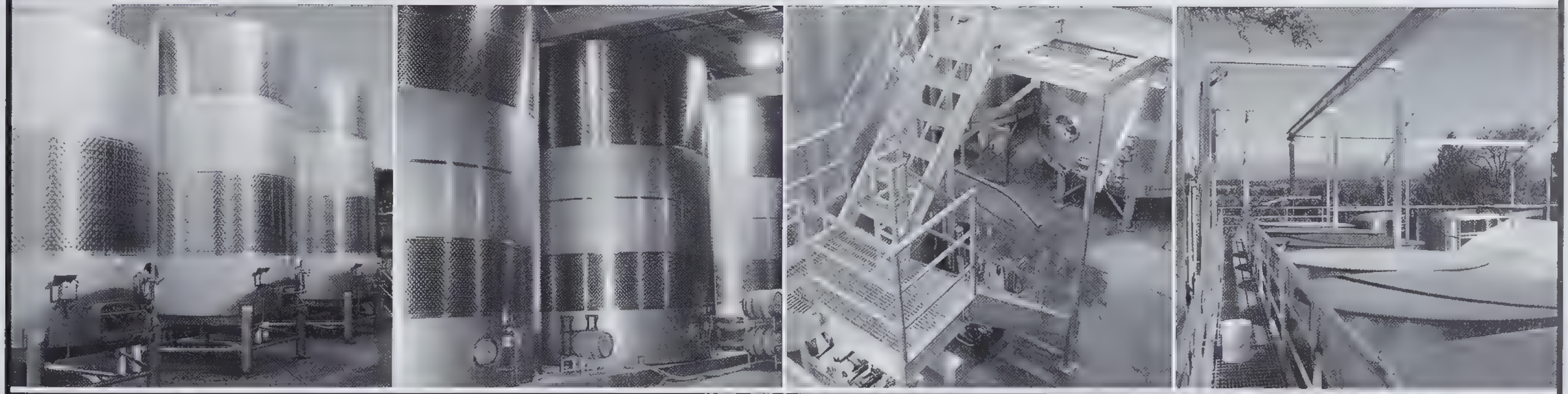

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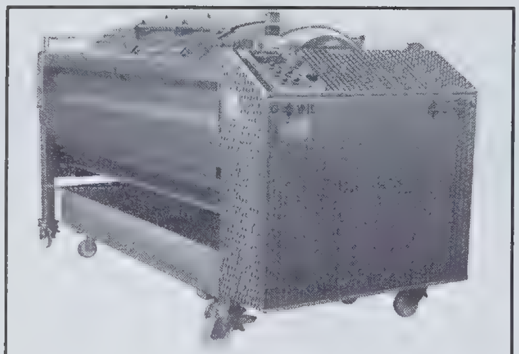
higher emissions scenario.[4] This range represents vast differences in the kind of world we will live in.

On the low end of the scale, where the average climate of Monterey today would be more like Sonoma in the future, most regions would have a range of suitable adaptation options, and conditions would be enhanced in some regions. By contrast, the higher end of the range represents a serious to devastating scenario of the future, where Los Angeles is warmer than Death Valley today. Clearly, continuing grapegrowing in such a vastly changed climate would be a serious challenge.

The probability of experiencing extreme climate events, such as very hot days or unseasonal freezes, can be represented by a bell-shaped curve, with the height of the curve representing the likelihood of experiencing the temperatures along the bottom of the curve (Figure V). Most days are somewhere in the middle, with very few days at either extreme.

Projections of climate change leading to increases in average temperatures (represented by the temperature curve shifting to the right in Figure V) helps to visualize why even small shifts in average temperature could mean important changes in impacts of concern at the extremes.

For example, days over a threshold such as 100°F where heat stress can affect vines become more likely with this shift in averages. This also shows why record cold events, such as the freeze in early 2007 that severely damaged the California citrus crop, can still occur even with global warming (though they do become less likely as average temperatures rise because of the shift of the curve to the warmer right-hand side). The timing of these extreme events is also important, as extremely hot days close to harvest can be more damag-



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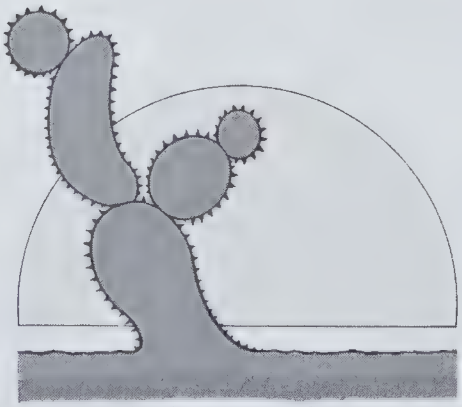

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ing than such temperatures earlier in the season.

Precipitation is also likely to be affected by climate change, with important implications for viticulture, although it is more difficult to project for the future than temperature. The recent assessment from the IPCC points toward wetter conditions in high latitudes and decreased precipitation in subtropical latitudes such as the southern U.S. and southern Europe.

California may experience a little of both, with a drier south and little change over much of the state. The state may also experience changes in fog patterns. Some climate models predict increased ocean upwelling from climate change, which might intensify fog development and summer onshore flow,[20] though better models of fog pattern are needed.

Warming, however, has additional effects on water availability and demand, independent of changes in precipitation. Warmer temperatures lead to more precipitation falling as rain rather than snow, reducing the valuable storage and gradual release of water that snowpack provides (particularly in California, where the state relies on stored water from melting winter snow to meet its peak water demands during the dry summer).

Even for growers who do not rely on snowpack to irrigate vineyards, increasing future demands for over-allocated water resources are likely to add stress for winegrowers. In addition, warming affects soil moisture through evaporation. Warmer temperatures lead to drier soils that, in the absence of increased rainfall, increase irrigation demand.[6]

WHY CARE ABOUT SOMETHING THAT MIGHT HAPPEN FAR OUT IN THE FUTURE? Climate change is not something that will happen in the distant future. It is something that is occuring now and can already be felt, and the emissions pathway we follow over the next few decades will set the trajectory for big differences at the end of the century.

The effects of greenhouse gases are cumulative. The greenhouse gases from our drive to work today will continue to exert their full climate-warming impact for up to a century. This means that the our climate for the next several decades is likely to experience similar amounts of warming, under every emissions scenario, because differences in emissions haven't had a chance to take full effect yet. (Note the overlap in projected temperatures for all the scenarios in Figure IV until about 2040.)

The differences in climate as a result of different scenarios of human greenhouse gas emissions begin to emerge

JMS Stylet-Oil
Controls powdery mildew, Botrytis, and mites

John Cosseboom, Western Farm Services, Monterey County, CA consults on over 10,000 acres of winegrapes, primarily Chardonnay. He makes several early-season applications of Stylet-Oil (1% solution) to control powdery mildew and achieve control of spider mites.

Kevin Skene, Skene Viticulture, Santa Rosa, CA manages 1,560 acres of winegrapes in Sonoma County. He has used Stylet-Oil for four years (post-bloom to veraison) to achieve optimal control of powdery mildew and botrytis when tank-mixed with systemic fungicides. He also uses Stylet-Oil to suppress mite populations, and has been able to reduce the need for miticides by up to 70% in vineyards with a mite history. Stylet-Oil may help to suppress mealybug crawlers.

Steve Mudd, Mudd Vineyards, Southold, NY manages more than 450 acres of winegrapes on Long Island, NY. He makes five or six applications per year (starting post-bloom) of Stylet-Oil to control powdery mildew, and also achieves control of red spider mites with a maximum 1.5% per 100 gallons of water application.

see Supplier Showcase, page 76 for product information

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after that time, and these differences amplify over time, leading to the large range of projections by the end of the current century (year 2100), see Figure IV. Further extending the time period over which greenhouse gas impacts are felt is the long time it takes for the vast ocean to respond to changes in the atmosphere.

In California, temperatures are projected to warm an additional 0.6°C (1°F) by 2020; during this time, climate conditions will remain within the range of variability experienced in the past.[9] After that time, the warming will be more than we have experienced with historical variability. This means that we would be experiencing essentially new climates in familiar places, climates that behave differently than they have in the past.

This starts to move outside a range where past experience is a good guide for what to do in the vineyard. Given that the average lifetime of a vine is at least 20 years in California, this means that vines in the ground now and those planted in the future will be experiencing new climate regimes that could affect their growth and quality.

WHAT MIGHT CLIMATE CHANGE MEAN FOR VITICULTURE? We know that both the average growing-season climate and temperature extremes such as very hot days can affect vine and fruit development. Generally, prices are substantially higher for fruit from even moderately cooler regions. For example, Cabernet Sauvignon from the Fresno district sold for about $260/ton in 2006, compared with fruit from the Napa district, which sold for over $4,100/ton.[2] This 15-fold difference in price was accompanied by only a 2.7°C (5°F) cooler average annual temperature.

Up to this point, it appears that the modest warming experienced has been positive for grapegrowing in many regions. For example, the incidence of frost in Napa and Sonoma has been substantially reduced with the warming experienced over the last 50 years,[13] and cooler winegrowing regions such as the Mosel Valley in Germany have had more good vintages.

However, further warming is poised to be a risk for many regions. For example, D. B. Lobell *et al.* showed that wine grapes in California are already growing within 1°C (1.8°F) of a modeled optimum for springtime temperatures, after which yields were projected to flatten out and then decrease.[10]

ISN'T THE WINE INDUSTRY PROTECTED FROM CLIMATE CHANGE DAMAGE? The wine industry has some advantages in dealing with climate change. Much of coastal winegrowing in California, for example, does not use water from the Sierra snowpack, which is projected to decrease substantially under climate change. Because of the relatively high crop value, many growers can afford to invest in adaptation resources that might not be feasible for less valuable crops.

However, winegrowing is highly climate-sensitive. Even small changes in temperature could have big impacts on the industry. The industry needs to sustain a critical mass of successful producers to support services, markets, and the value of appellation names. The wine industry will operate in a broader context; in a more water-stressed world in the future, water allocations and rights will be more critically examined.

WHAT CAN WE DO? There are two basic types of response to climate change: working to adapt to or manage the impacts experienced, and trying to prevent or minimize further change (mitigation). These are not mutually exclusive, and in fact, both are increasingly regarded as necessary.

Grapegrowers are highly resourceful, and some adaptation-options to warmer temperatures are likely to be pursued. These might include new trellising techniques, wider adoption of precision irrigation practices, and

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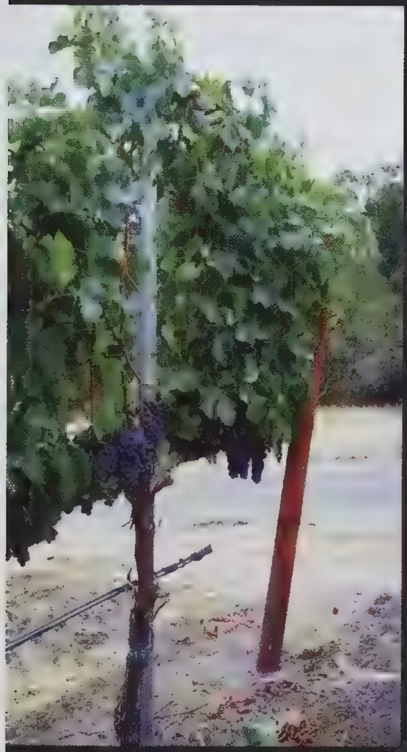

planting of new grape varieties in existing sites (including breeding new, more heat-tolerant varieties). However, this is where the celebrated geographical specificity of wine may limit adaptation-options. How would consumers and producers feel about Russian River Cabernet Sauvignon instead of Pinot Noir, or about some heat-tolerant but unfamiliar Spanish varieties replacing Cabernet Sauvignon in Napa Valley?

Genetic solutions seem unlikely. Despite great advances in grape breeding, which have resulted in the adoption of many new varieties in the table grape and roostock industries, essentially no new varieties of wine grapes have been widely commercially adopted in the last 50 years.[5] Another option is to shift the location of plantings, for example, to cooler regions closer to the coast or further north. But this presents obvious problems for small growers with limited holdings — and long traditions — in a specific region.

Adaptation measures are likely to work only for a certain range of climate warming. Limiting the change experienced to this lower end of the range, where adaptation options are most feasible, seems prudent.

In order to avoid warming that would entail unacceptably high levels of negative impacts, the European Union has determined a goal of limiting the warming experienced to less than 2°C (3.6°F) above pre-industrial times. This would probably require stabilization of CO_2 in the atmosphere at or below 450 ppm, which would, in turn, require that global emissions peak within the next several years to two decades at most, and then begin to decline.[11,12]

California has recently adopted a climate policy (the Global Warming Solutions Act, AB 32) that puts the state on track to strongly reduce emissions and minimize damage from climate warming. Regulations are currently being developed under this new law to determine how to meet the global warming pollution reduction targets of nearly 29% by 2020 and 80% by 2050 to which the state has committed.

Agriculture is responsible for only 8% of the state's greenhouse gas emissions,[3] but it is disproportionately sensitive to climate change. Clearly, emission reductions must come from all over the world, but as the twelfth largest greenhouse emitter globally, the state is setting a strong precedent for other players to follow.

The wine industry is starting to recognize the issue of climate change on local, state, national, and international levels, which is essential to be proactive in developing response strategies. A sound strategy will involve both adaptation to the inevitable warming (for example, investments in new technology) and mitigation to reduce greenhouse pollution to leave open the widest array of options in the future.

Innovative local adaptation efforts include a new project of the Napa Valley Vintners to work with climate scientists to understand the historical climate of the region, and what this might imply for the future (see www.napavintners.com).

On the mitigation side, reductions in greenhouse gases can come from individual and business decisions about transportation, lighting, and building construction, or from national policies for incentives and large-scale energy systems.

The wine industry has the opportunity to contribute to mitigation efforts through attention to its own CO_2 footprint, and as a leader for others to emulate. But because the direct environmental footprint of agriculture is a small fraction of emissions (8% in California),[3] effective mitigation will have to involve political leadership and policy development. The wine industry has the potential to be an effective advocate for local, state, national, and international policies that can limit climate changes to the range consistent with sustaining a vibrant industry. ■

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Well-spaced shoots on vertical shoot-positioned Chardonnay vines after mechanized shoot-thinning with Korvan 2220 tow-behind tool carrier.

VINEYARD MECHANIZATION

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Several growers have adopted the relatively new practice of mechanical shoot-thinning to their mechanized vineyard operations in addition to pruning and cluster-thinning (when necessary), to achieve sustainable quality and yield with minimal labor input. *PWV* offers four case studies below, sharing experience in California, Washington, and Missouri.

MESA VINEYARD MANAGEMENT (CALIFORNIA)

Mesa Vineyard Management [Templeton, CA] has purchased a Korvan-2220 tow-behind tool carrier with a self-contained hydraulic and electronic control system (hydraulically-powered by the tractor). Two operators are seated in the tool carrier with hand controls to guide boom-mounted attachments with electric-over-hydraulic control of the boom lift-and-swing movements.

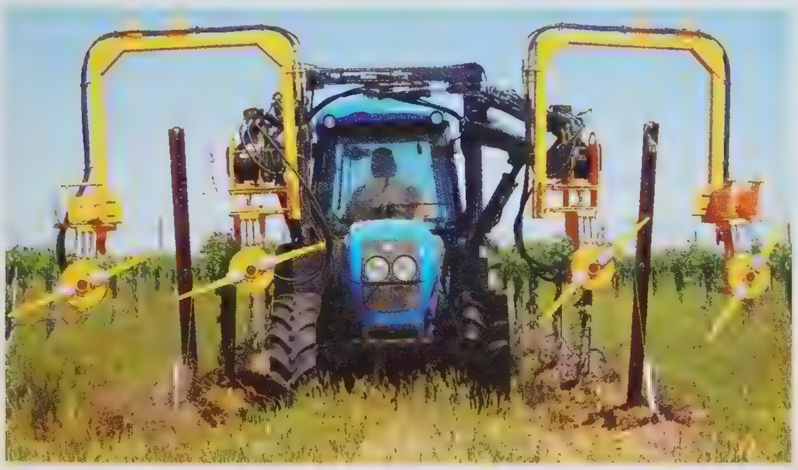
"We rented a Korvan tool carrier in 2006 and began operations on 60 acres located in four vineyards," recalls Gregg Hibbits (general manager, Mesa Vineyard Management). "In 2007, we increased acreage to about 300 acres on five vineyards. The Korvan tool carrier was used to prune all vineyards. Later in the season, shoot-thinning was done, and removal of unwanted shoots from the underside of the cordon, and crop-thinning as necessary.

"With purchase of the Korvan-2220, we hope to do four passes (if all four are deemed necessary) over 700 acres in 2008: mechanical-pruning, shoot-thinning, sucker-removal below the cordons, and cluster-thinning on five ranches in San Luis Obispo and Monterey Counties.

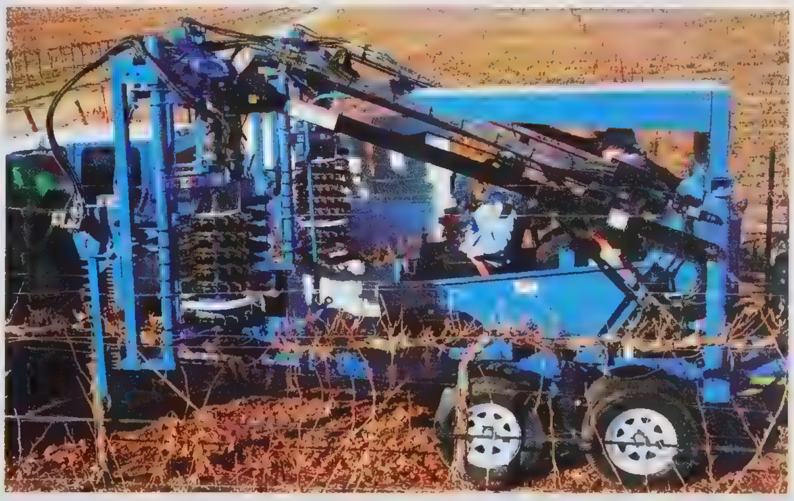
"Our grape-priority for mechanical applications is Cabernet Sauvignon, Merlot, and Syrah that yield five to seven tons per acre. We have three trellis configurations: vertical shoot-positioned, modified sprawl, and Smart-Dyson. In general, machine activities work better once the cordon is completely established, that is once the wire is filled. That generally occurs in the fourth or fifth year.

"We pull the Korvan tool carrier with a John Deere-6420 in tractor-row widths from 10-feet down to eight-feet. A John Deere-5520 pulls the Korvan tool carrier in six-foot wide tractor-rows. The unit is operated in one 10-hour shift per day at 2 to 2.5 mph.

"Pruning with a tow-behind tool carrier is basically an attempt to mechanically-prune spur-pruned vines within a very tight 'box.' We are trying



A Korvan 1220 tool carrier with a rotary-paddle attatchment is used to remove approximately 40% of the shoots from Cabernet Sauvignon vines (Ste. Michelle Wine Estates, Washington).



Mechanized pruning with Korvan 2220 tow-behind tool carrier at Red Hills Vineyard (Creston, CA).

to avoid ending up with an annually expanding area of dead wood around the cordon.

"The tool carrier with rotary pruning equipment allows us to fine-tune mechanical pruning because of a high level of specificity in pruner operation, achieved by having a person only focus on the operation of one rotary pruning head. Our goal is not necessarily to end up with 125% or 175% of desired buds, but to end up with a 'tight box,' that will have more buds than are necessary.

"The 'fine' adjustments from approximately 175% of desired bud count to 150% to 100% are achieved by the subsequent operations of shoot-thinning, cordon-brushing, and cluster-thinning. The progression could also be 150% at pruning reduced to 100% at shoot thinning with no cluster thinning needed, or any other possible combination of operations.

"We begin shoot-thinning when shoots are an average of six to 12 inches in length.

"Shoot-thinning (by hand), tends to be a 15- to 25 man-hour per acre operation, depending on shoot growth (longer shoots take more time) and how 'clean' the shoot thinning needs to be. The tow-behind tool carrier requires two people plus tractor driver and one or two supervisors to count shoots. If we can do two acres per hour with the tool carrier, that is roughly 2.5 man hours per acre. The man-hour cost calculation will be higher for the mechanical operation as tractor drivers earn $10 to $12 per hour and a thinning crew member earns $8 to $9 per hour.

Cluster-thinning is generally the last canopy operation of the season and may be eliminated if the crop estimate is low or on-target. The determination on cluster-thinning is made on a block by block, variety by variety basis."

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"Cost savings calculation is difficult," says Dana Merrill (president of Mesa Vineyard Management). "On average, we believe that we probably save in the range of 15% to 20% compared to conventional pruning, that includes a quick clean-up pass around the tall vine-stakes.

"We feel the pay-off will be, as labor rates rise, our costs will remain fixed, to some extent. The comparison will then swing more favorably to the mechanical approach. I expect that growers selling grapes for $1,200 or less will not be able to afford many of the common hand-labor practices used today such as pruning, cordon-suckering, weak shoot-removal, and cluster-thinning. But some wineries will be more supportive than others as transitions are made, similar to the reception that mechanical grape harvesting received in the early years."

French Camp Vineyards (California)

French Camp Vineyards (Santa Margarita, CA) operates three Korvan-2220 tow-behind tool carriers on 1,100 acres of six varieties of red and white grapes. In three passes during the year, pruning, shoot-thinning, and cluster-thinning operations are performed on vertical shoot-positioned vines, two-foot wide Lyre, three-foot wide quadrilateral trellis, and two-foot wide U-Lyre trellis.

"We began trial-development on about 50 acres in 2002 with purchase of tractor-mounted machinery from Fresno State University," recalls Hank Ashby, French Camp vineyard manager. "In 2003, the manufacturer, OXBO International, delivered the first two-row trailer tool carrier with dual booms, dual operator stations, and a supervisor platform on a lease.

"We operated two trailers with an OXBO rotary shoot-thinning attachment on 450 acres. We also used a cordon-impactor cluster-thinning attachment suitable for horizontally-divided trellises such as quadrilateral and lyre.

"In 2004, we purchased three improved second generation OXBO tool carriers including sickle-bar pruners to operate on 900 acres. We trialed a single-action sickle bar vine trimmer and horizontal and vertical trunk brush-cleaner prototypes.

"By 2005 we increased to 1,100 acres under mechanized farming practices. We look forward to continuing at this level into the future with the three machines that we now own."

"We have conducted trials every year to compare grape quality from hand and mechanized procedures on Cabernet Sauvignon, Cabernet Franc, Chardonnay, Sauvignon Blanc, Shiraz, and Zinfandel. We are achieving equal quality from mechanized blocks at a cost savings of 47%.

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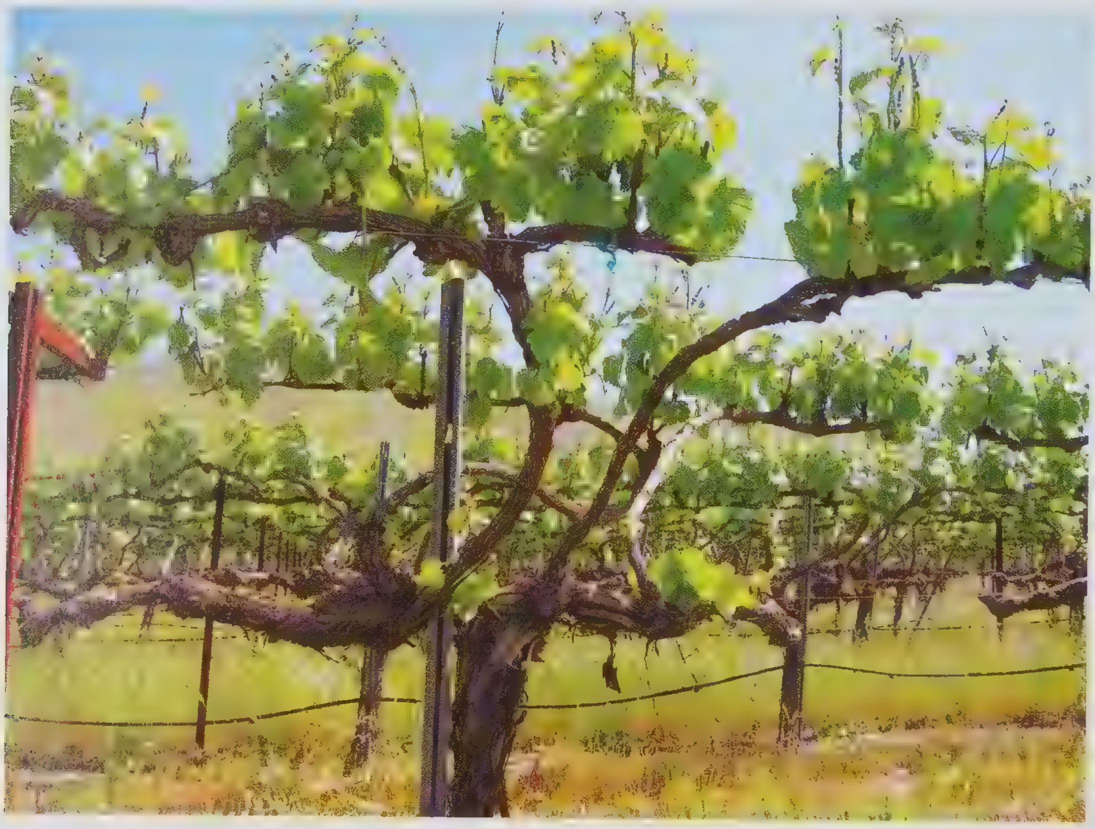

Quadrilateral cordon vine after mechanized shoot-thinning at French Camp Vineyards (Shandon, CA) with seven clusters remaining, per linear foot of cordon.

"The balanced cropping system is very sustainable. When we started the project, we expected we would have to do a 'clean up' every four or five years, but it appears not to be necessary. New spurs appear each year as we move the pruning cuts closer to the cordon," concludes Ashby.

STE. MICHELLE WINE ESTATES (WASHINGTON)

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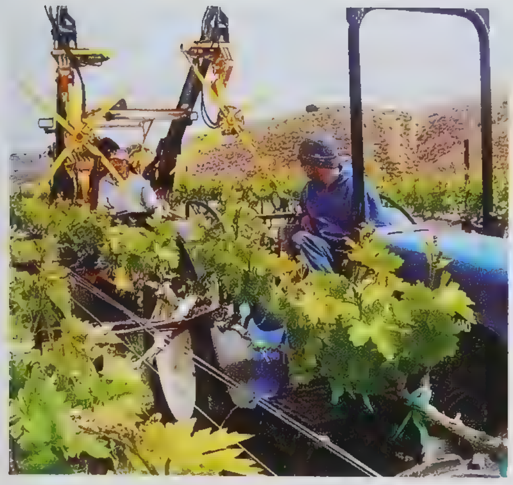


Mechanized shoot-thinning with Korvan 2220 tow-behind tool carrier at French Camp Vineyards (Shandon, CA).

constraints," explains Dr. Russell Smithyman, (director of viticulture & research, Ste. Michelle Wine Estates, Washington state).

Ste. Michelle Wine Estates continues to develop and utilize other precision viticulture practices along with mechanization, that have great potential for improving wine quality while reducing production costs, such as differential mechanical harvesting.

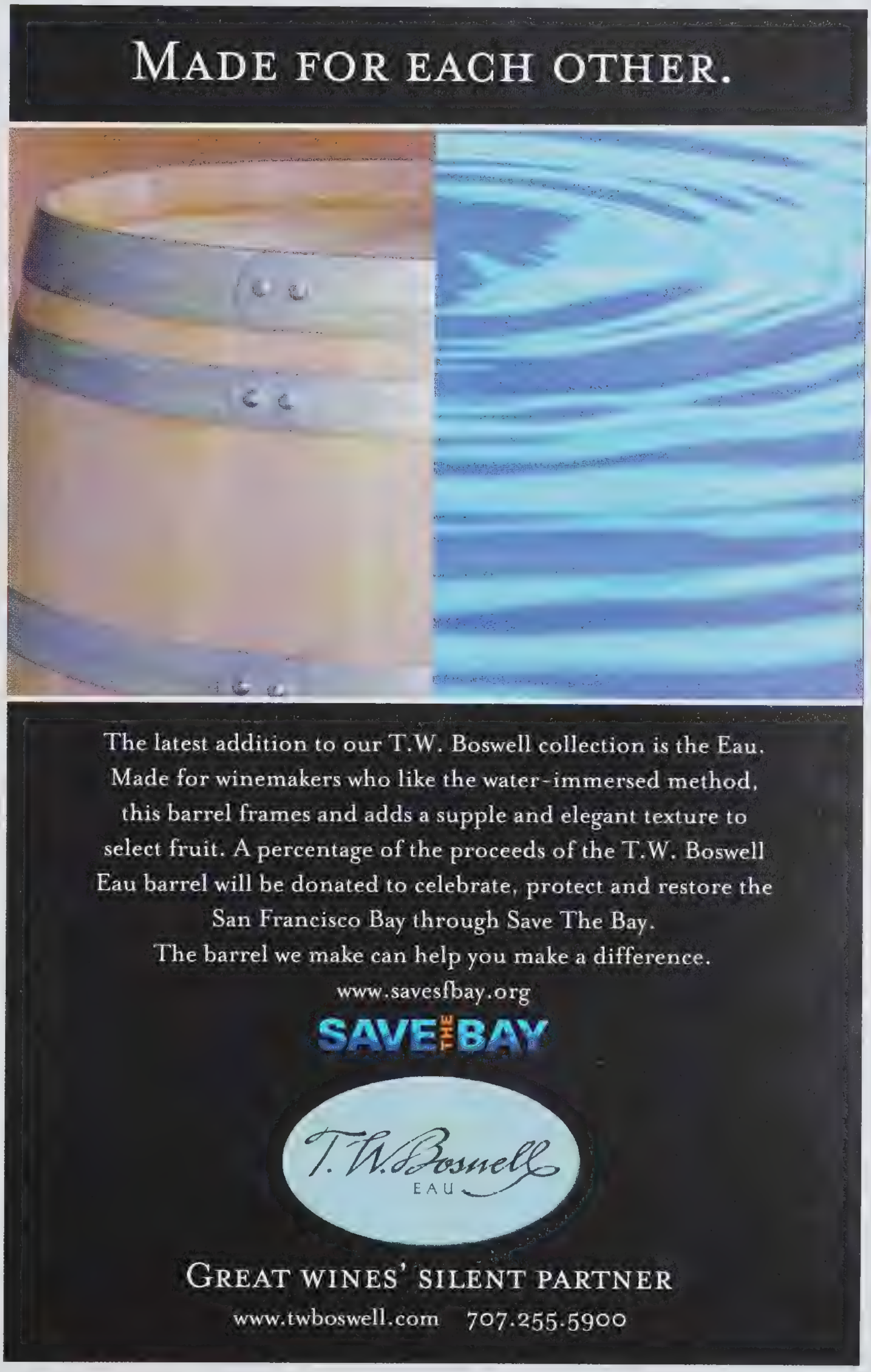
In 2007, a Korvan tractor-mounted rotary-finish pruner was used to mechanically pre-prune two rows simultaneously (single tractor-pass) of 100 acres of Cabernet Sauvignon vines.

"The rotary-finish pruner was used to prune vines to a tighter tolerance," adds Smithyman, "which, in effect, minimized hand follow-up. For Cabernet Sauvignon, the trellis is a VSP setup farmed as a sprawl — four movable wires (two on each side), and one fixed wind-wire on top.

"For shoot-thinning, a rotary-paddle attachment was used to remove approximately 40% of the crop load from the top and sides of the cordon (shoots are six inches in length).

"The 1220 tool carrier uses ground sensing radar and user inputs to the OXBO Plus 1 computer system, to maintain constant speed calibration of the rotating urethane fingers, regardless of forward tractor speed and wheel slippage. The driver uses a single joystick to manipulate the height and lateral position of each head independently. Our operators have become quite good at driving the tractor while juggling the duties of shoot-thinning two vine rows."

A rotary cordon-brush was used to remove shoots from the bottom of the



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cordon and the side of the trunk (from the drip-wire up to the cordon).

"We were very impressed with the openness of the canopy after shoot-thinning. We were very impressed with the cordon-brush and removal of trunk-suckers; so much so that we expanded use of this implement into additional vineyard blocks.

"We experimented with cluster-thinning in a few rows but do not yet have any firm conclusions. We will experiment with the cluster-thinning attachment on a larger scale in 2008.

"In 2008, we plan to operate the Korvan-1220 tool carrier on the same 100 acres of Cabernet Sauvignon plus 30 acres of Chardonnay. With the results achieved in 2007, and the expected results in 2008, we feel confident that this program will work in other varieties such as Merlot and Syrah.

"Pre-pruning costs with the Korvan-1220 double-arm tractor-mounted tool carrier were 50% of conventional single-row pre-pruning costs. The follow-up hand-pruning pass, a quick (walking-pace) pass to remove hangers in the first year, was 25% less cost than our conventional pneumatic pruning pass.

"For shoot-thinning, we incurred 20% of normal hand shoot-thinning costs. We also feel that a cordon-brush pass, combined with a well-timed chemical-sucker pass, could potentially, depending on seasonal conditions, eliminate the need for a hand-sucker pass.

"We feel that the Korvan tool carrier system has the potential to play an important role in our goal to improve quality at reduced costs in many vineyards. We will continue to investigate its use to improve wine quality, but also its use in combination with other precision viticulture technologies to improve vineyard uniformity and sustainability," concludes Smithyman.

ST. JAMES WINERY (MISSOURI)

St. James Winery (St. James, MO), Oxbo International Corp., and the University of Missouri began a study in 2006 to evaluate the effects of mechanical-pruning and shoot-thinning compared to manual operations on Chardonel (a hybrid winegrape with parentage of Chardonnay X Seyval blanc).

Mechanization of hybrid cultivars such as Chardonel may be more complicated than for *V. vinifera* and *V. labruscana* because many are, at least, moderately fruitful from non-count, basal buds and from secondary buds. Consequently, shoot growth from either origin can contribute to yield, and this attribute warrants close study.

The experimental plot (approximately five-acres) is located within 12 acres of Chardonel vines six years old within the St. James' Tower Vineyard in central Missouri. The vineyard is planted on a Union silt loam soil with artificial drainage and drip irrigation. Vines are grafted to 3309C rootstock. Vine and row spacing is 7-foot x 9-foot, respectively, and vines are trained to a high bilateral cordon that is shoot-positioned downward.

Treatments include hand-pruning plus hand shoot-thinning, hand-pruning plus mechanized shoot-thinning, mechanized-pruning plus hand shoot-thinning, and mechanized-pruning plus mechanized shoot-thinning.

Hand-pruning to short fruiting canes was performed to retain 20 nodes per pound of pruning weight, while mechanized-pruning was to a 13-inch square box positioned as low on the trellis as possible.

Shoot-thinning, both by hand and machine, was to three shoots per foot of canopy as specified by the vineyard manager. Mechanical-pruning and shoot-thinning were performed with a Korvan 1210 tool carrier. Data being collected for this experiment include yield and yield components, vegetative growth, leaf area by shoot origin, and fruit composition by source (count, non-count, and lateral shoots).

Data were collected from 320 vines in 2006 and 2007. Unfortunately the data collected for the 2007 season were significantly impacted by the severe freeze that occurred in early April. Because these seasons have been so different, and because 2007 data collection is not yet complete, no strong conclusions from our data have been made, but there are two general observations:

First, mechanized pruning, as performed, retained node numbers nearly double that of hand-pruning. In combination with the fact that 2006 season-end shoot densities appear to have increased significantly after shoot-thinning, we suspect we may need to machine-prune Chardonel vines more aggressively.

The experimental protocol will be amended to more precisely monitor post-thinning shoot development. Allowing the development of shoots and crop from non-count buds may improve balance in this cultivar.

Second, yield data from the 2007 season demonstrate a numerical yield advantage for the machine-pruned vines. Further analysis of the data is under way. We hope for "normal" conditions in 2008 and 2009 to allow a more thorough examination of the effects of these practices.

"We will operate the Korvan 1210 tool carrier on all of our 20 acres of Chardonel in 2008," says Andrew Hofherr, St. James Winery president.

Report by Eli Bergmeier, Keith Striegler (University of Missouri ■

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Napa County viticulture adviser, Ed Weber

Napa County, the California wine industry, and *PWV Journal* lost a trusted advisor when Ed Weber, 51 years old, died unexpectedly December 31, 2007. Weber collapsed as he rode his bike to a volleyball game in Yountville. The cause of death was a heart condition.

Weber grew up in Covina (Los Angeles County). He earned a bachelor's degree in plant science and a master's degree in horticulture/viticulture from UC Davis. He then spent a year at the Riecine Winery (Gaiole, Italy), working as assistant to the winemaker and vineyard manager. In 1983, he became the viticulturist for the Joseph Phelps Winery (St. Helena, CA).

In 1988, he joined the UC Davis Cooperative Extension as the Napa County Farm Adviser. In 2001, he was promoted to the position of county director, where he served as a liaison between the university and its researchers, growers, winemakers, and state and local regulatory agencies.

Weber educated the public on the latest research on pest management, techniques for getting the best yield and quality from vines, and other facets of viticulture. He could take the most complicated data and convey its importance to the general public in a concise, clear way.

"He was kind of the go-to person if you were interested in planting a vineyard," said Napa County Agricultural Commissioner David Whitmer, "or trying to determine what was wrong with problem vines.

"Ed was a very dear friend and I will miss him very much! I want to express to the entire Weber and Jungerman families my sincerest condolences. Anne, Reid, Grady, Owen … all of us in Napa Valley recognize and share in your loss. Your husband, your father was a very special man. He lived his life with such honesty and integrity.

"Ed touched the lives of many people. He had a keen sense of what was important in his life … You — his family! He was there for you … made time for you … went camping and hiking with you and couldn't wait to leave his office to come home to you. I want you to cherish the memories you have of your father. You can keep him alive in these memories … I also want you to know he will never be forgotten because people will meet you and know you and through you will forever know Ed Weber!"

"I first met Ed when he went to work with Joseph Phelps Vineyards," recalled Whitmer. "I did not really get to know him until he came to work for the University of California Cooperative Extension. Ed and I worked together for more than 20 years.

"He had this ability to take the most complex and overwhelming issues and calmly and almost peacefully go about making positive things happen.

"If you think about the timeframe when he joined UC Cooperative Extension as Napa County Viticultural Farm Advisor in 1988, many Napa County growers were dealing with the effects of phylloxera. Vineyards needed to be pulled and re-planted; new rootstocks were being tested in different soil types; changes were being made in vineyard layout and design, vine spacing, canopy management, trellis systems … the industry was in the process of a major re-tooling.

"Fortunately, Ed was working with them! This is one example of why Ed was so popular in Napa Valley. He had answers to many questions that were needed to help people with their problems. If he didn't have an answer to a question, he would seek it out or work within the university system to try and come up with the answer.

"Ed is responsible for much of the success that is celebrated in Napa Valley," concluded Whitmer.

"It's a very tragic loss of a great human being," said Ted Hall, owner of Long Meadow Ranch Vineyard (Rutherford, CA). "Ed was a quiet, solid, good-natured deliverer of knowledge and competence, and he did it in a way that never ruffled anyone's feathers. He was always perceived as being helpful and thoughtful and never critical."

Weber was a problem solver, utilizing his technical knowledge and dry humor to advise local vintners about rootstocks and wine grape production. He produced an online newsletter, *Vineyard Views*, containing the latest information and inspiration on growing grapes. He alerted vintners to potential threats to Napa's vineyards such as the vine mealybug and glassy-winged sharpshooter.

"He was a consummate professional," said Sandy Elles, executive director of the Napa County Farm Bureau. "He was well-respected and admired by everyone in the wine industry. As the county viticulture adviser, he was the go-to man for your problems and concerns. He always responded with caring concern and a knowledge base that was astonishing."

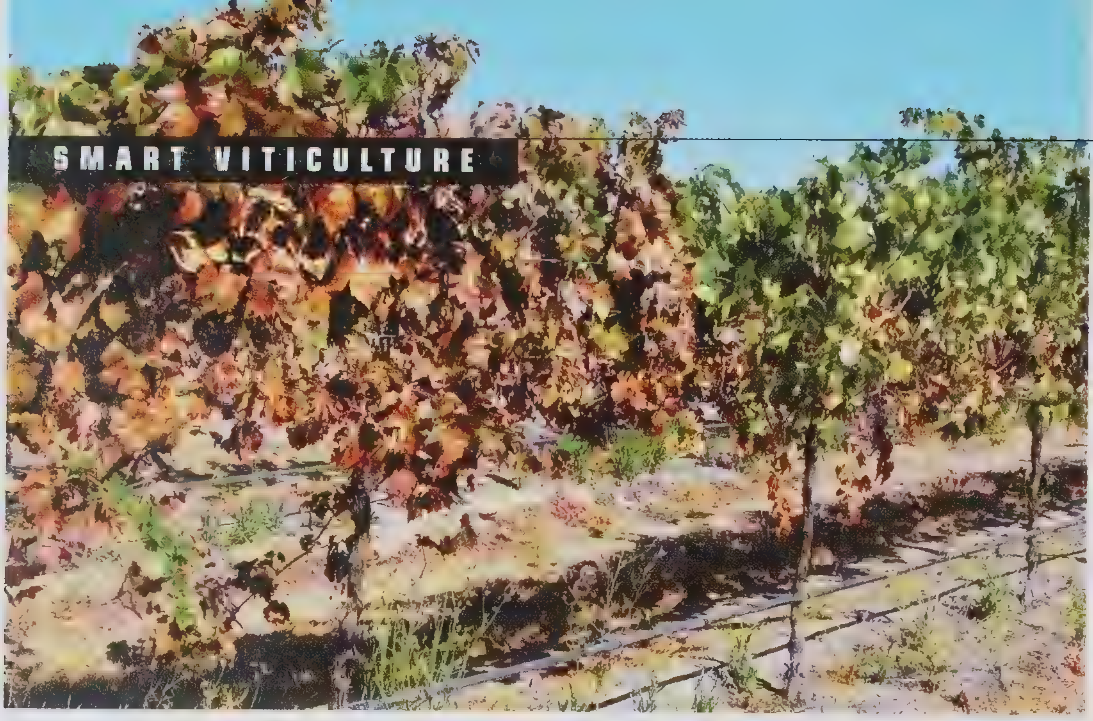
Weber married his college sweetheart, Anne Jungerman, in 1985 and the couple had three sons: Reid, Grady, and Owen. Weber's survivors include: his mother, Wanda Minnick Weber (Napa); and sisters Susan Weber (Berkeley), Jane Weber McCabe (Laguna Hills), and Marilyn Weber Kleinhein (Los Angeles).

"He was very devoted to those boys, and also a bit of a kid himself," Susan Weber said. "He was a really enthusiastic athlete and outdoors person. … He loved biking. He loved hiking. If there was a lake, he'd jump into it. He was real involved in the boys' sports teams. That was all pleasurable to him; it wasn't dutiful. I think he had a great boyhood. I do not think that man had an enemy."

Weber was a highly skilled volleyball player who coached and refereed high school and college volleyball matches, and he also loved working in the garden.

Weber was a Contributing Editor to *Practical Winery & Vineyard Journal* for 15 years, starting in 1993. He was Senior Author of five texts and a junior author of another five texts published between 1991 and 2006. His helpful peer-review to improve the quality of many texts was much appreciated.

PWV Journal is indebted to Weber for his contributions. ■



LEFT: Syrah disorder vine (left) and healthy vine (right), east of Paso Robles, CA October 2004. Affected vines show symptoms very similar to leafroll virus, but generally test negative for leafroll. Foliage turns reddish-brown in late summer, and fruit ripening is impaired. Affected vines do not have trunk lesions or die inexplicably as with Syrah Decline. (Photo by Mark Battany) Bottom-Left: Bright red leaves and a swollen graft union. Bottom-Right: Vine with typical "virus-like" symptoms.

The third plague? Syrah red leaf disorder

BY Dr. Richard Smart

Is California the unlucky wine state? I have been visiting there now for over 35 years and so am familiar with the ups and downs of the local wine sector.

I have witnessed the problems of phylloxera devastation caused by the AXR-1 rootstock failure and, more recently, the threat of Pierce's disease with the glassy-winged sharpshooter. Lesser problems have occurred with the vine mealybug and the recent invasion of the Australian Light Brown Apple Moth, which promotes Botrytis.

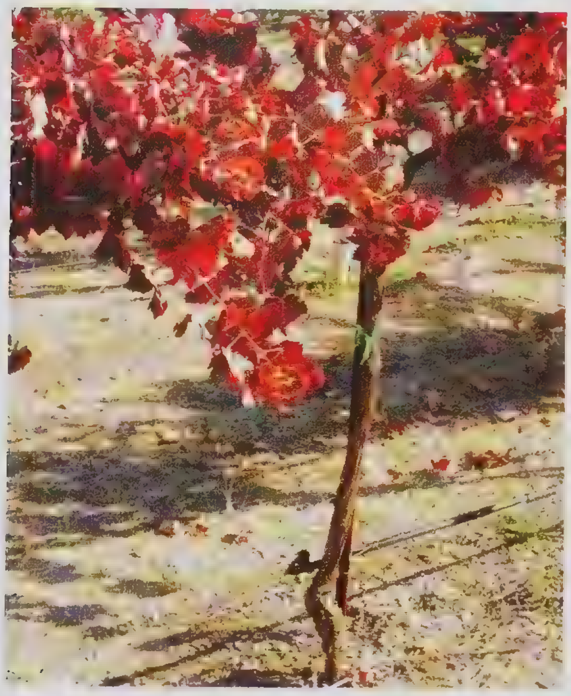
Now it appears that a new threat is looming, though it is very early to understand how significant it may become.

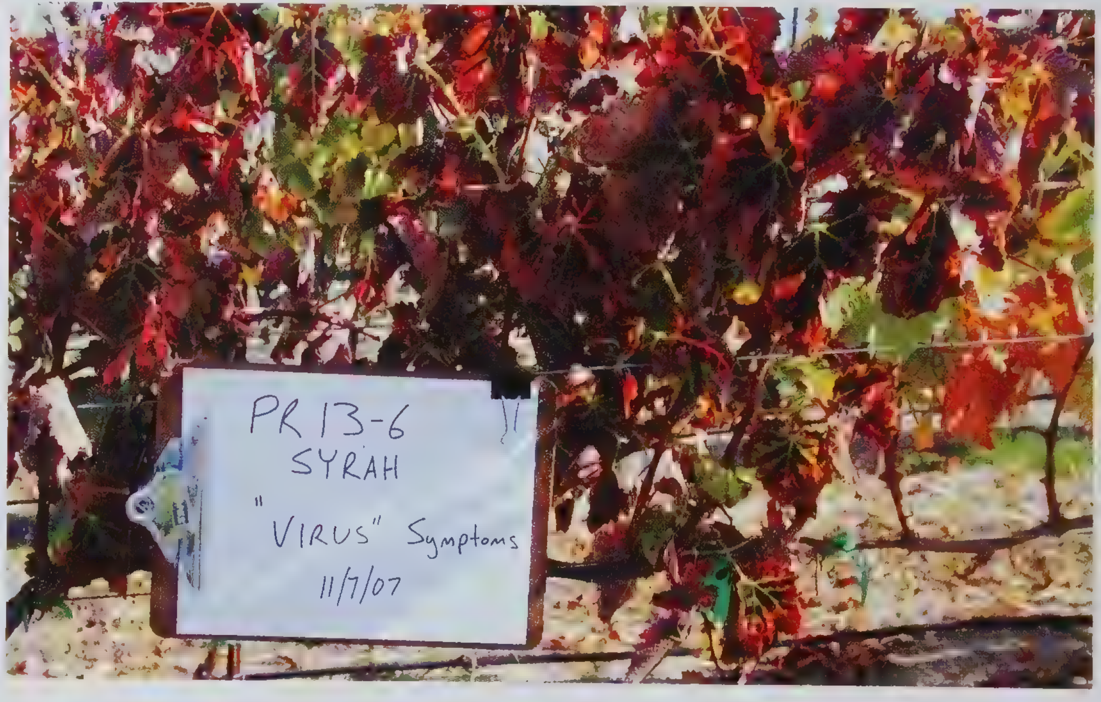
Phylloxera revisited, human error?

I remember visiting California in the early1980s when I was living in New Zealand. Among my first tasks while doing research in New Zealand was to study a phylloxera invasion in the Gisborne region vineyards. Ever eternal optimists, the kiwis had planted the majority of their new vineyards on own roots, despite phylloxera having been established in the Auckland region for 80 years.

I had the good fortune to study this invasion with entomologist colleague Dr. Doug King. He was the first to hypothesize, and then prove, that above-ground crawlers of phylloxera could be spread by wind and also by machinery from vineyard to vineyard. King was also interested in the ideas that not all phylloxera strains were the same and that New Zealand had received a low-virulence biotype on its chance introduction. So, for example, AXR-1 performed satisfactorily in New Zealand, despite its failure in Europe. Initially, AXR-1 also did well in California.

During a visit to California in the early 1990s, I discovered (to my horror) that rooted-vines were being imported from New York state nurseries, due to vine shortages in California. I recall speaking to colleagues at UC Davis about the threat that this posed, because of the likelihood of importing more virulent strains of phylloxera.





The rest, as they say, is history. A new, more virulent biotype of phylloxera was discovered, and many tens of thousands of acres of California vineyard planted to AXR-1 had to be up-rooted because of failure of the rootstock.

Was this new biotype a mutation, or was it an accidental import from New York? The cost of not recognizing this potential problem was indeed high.

Glassy-winged sharpshooter, human intervention working?

The destructive Pierce's disease (PD) has been well established in vineyards in the North Coast and Southern California for many years. Vines die a few years after infection. Fortunately, PD remained a local problem for many years because the insects that spread it have a limited flight distance from their habitat beside creeks.

Then the glassy-winged sharpshooter began to cause more widespread PD-devastation in vineyards because of its ability to fly long distances. It spread naturally northwards in the Central Valley, but a quarantine has stopped it establishing in North Coast vineyards. We all hope that the quarantine will continue in effectiveness.

Interestingly, the glassy-winged sharpshooter has spread from island-to-island across the Pacific Ocean, and one was even found at an Australian airport!

Syrah red leaf, the next big threat?

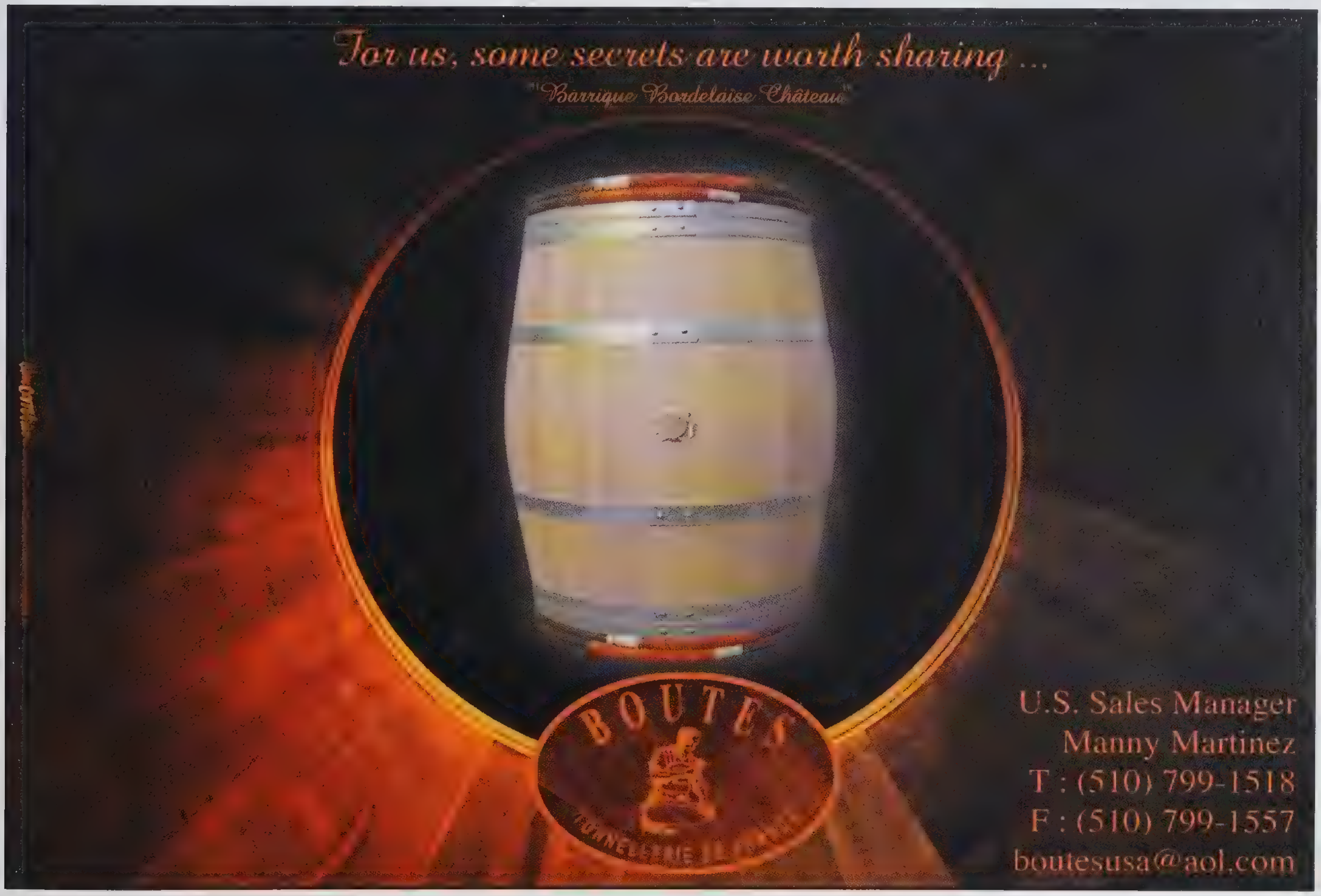
I first recall seeing Syrah red leaf disorder in the mid-1990s in a vineyard in northern Monterey County. (I use the term Syrah red leaf disorder in a generic sense, realizing that there may be several diseases or problems which can cause this). There, new plantings of Merlot and Syrah developed red leaves around veraison, and fruit accumulation of sugar and color was substantially delayed. Canes often failed to lignify.

Marking symptomatic vines showed that the condition was spreading to adjacent vines in the row and across the rows in a down-wind direction. These were indicators to me of an insect vector spreading the disorder. Some vines died.

These newly planted vines in Monterey County were near an older block of Chardonnay vines that showed the most extreme leaf roll virus-like symptoms that I have ever seen. The growth was very stunted in general, and I wondered if this old vineyard might be the source of the infection.

I subsequently saw many examples of what appeared to be a similar disorder with Syrah in vineyards east of Paso Robles. Some of my clients made wine from the affected fruit and discovered that its impact on wine quality was especially severe. It became common practice to drop the fruit on affected vines.

The disorder was not restricted to Syrah, but also showed on Zinfandel,



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Merlot, Cabernet Franc, and Malbec. It may also be present in white varieties and be undetected.

I have seen young vines die with the Syrah red leaf symptoms, and I have seen evidence of clear down-row and cross-row spread. Whenever I see a condition like this in a client's vineyards, I suggest marking symptomatic vines at several different times, and at least once each year, to see if there is any evidence of spread.

All that I have seen in the field suggests spread by insects, which in turn are spread by wind also. Thus in newly-affected vineyards, one might observe individual symptomatic vines on the upwind side, which appear to develop into clusters with both down-row and cross-row spread.

One new vineyard showed evidence of clear spread from the upwind side, which was near bare ground, but down-wind from distant affected vineyards. One 12-year-old Syrah vineyard was to be removed because of spread of the disorder. If vineyards need to be up rooted at 12 years of age then this is indeed a severe problem!

I was frankly amazed that this widespread disorder attracted so little research attention. Many growers had virus tests done, which were inconclusive.

There were attempts, in several vineyards, to relate the condition to winter drought and/or potassium deficiency, but I always thought that these were remote hopes. Such conditions do not spread vine-to-vine; nor do they kill otherwise healthy vines. I know many water-stressed Shiraz vineyards in Australia that do not look like or behave like this.

I have seen Syrah disease in South Africa, which causes similar symptoms and has a similar effect on fruit ripening. It has been confirmed to be spread by mealybugs.

In Spain and California, I have seen another Syrah decline that seems to be associated with graft-union problems, where swelling is evident. Vines seem to develop weak growth symptoms and gradually die in ages ranging from young to over 10 years. This disorder seems to be similar to the Syrah disorder described in France.

In 2003, I saw a vineyard with very clear red leaf symptoms in Sonoma Valley. Perhaps now there are others. I thought that this would create some interest, and indeed it has!

In November 2007, Mark Battany and Rhonda Smith, University of California Extension viticulture advisors from San Luis Obispo and Sonoma counties respectively, organized a UC Davis Symposium

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on Syrah Vine Health (see NK http://groups.ucanr.org/Syrah/, here the proceedings are free). The room was nearly full, and credit goes to the organizers, particularly for inviting researchers from France and South Africa, where Syrah vine disorders also exist.

Reading the Proceedings of the symposium, it seems to me that we are dealing with two, perhaps three different problems. In France, the so-called "Syrah decline" seems to be associated with graft problems, and there are noted effects of clone and rootstock. The symptoms include swelling of the graft union. Various studies have implicated pathogens, including Rupestris Stem Pitting virus and perhaps phytoplasma diseases.

To the best of my knowledge, phytoplasma have not been recorded on grapevines in California, but they are major diseases in Europe and to a lesser extent in Australia. These diseases are also spread by sap-sucking insects and can be lethal.

In South Africa, they recognize two health problems with Shiraz or Syrah. "Shiraz decline," as reported there, seems very similar to the health problem reported in France, and I do not think, based on symptoms I have seen, that this is the same as the widespread problem in

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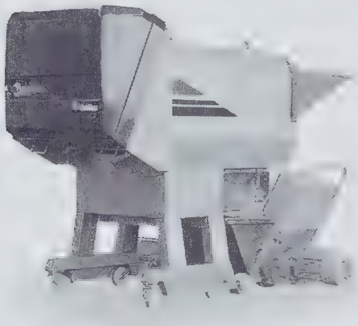

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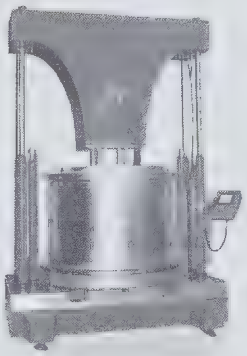

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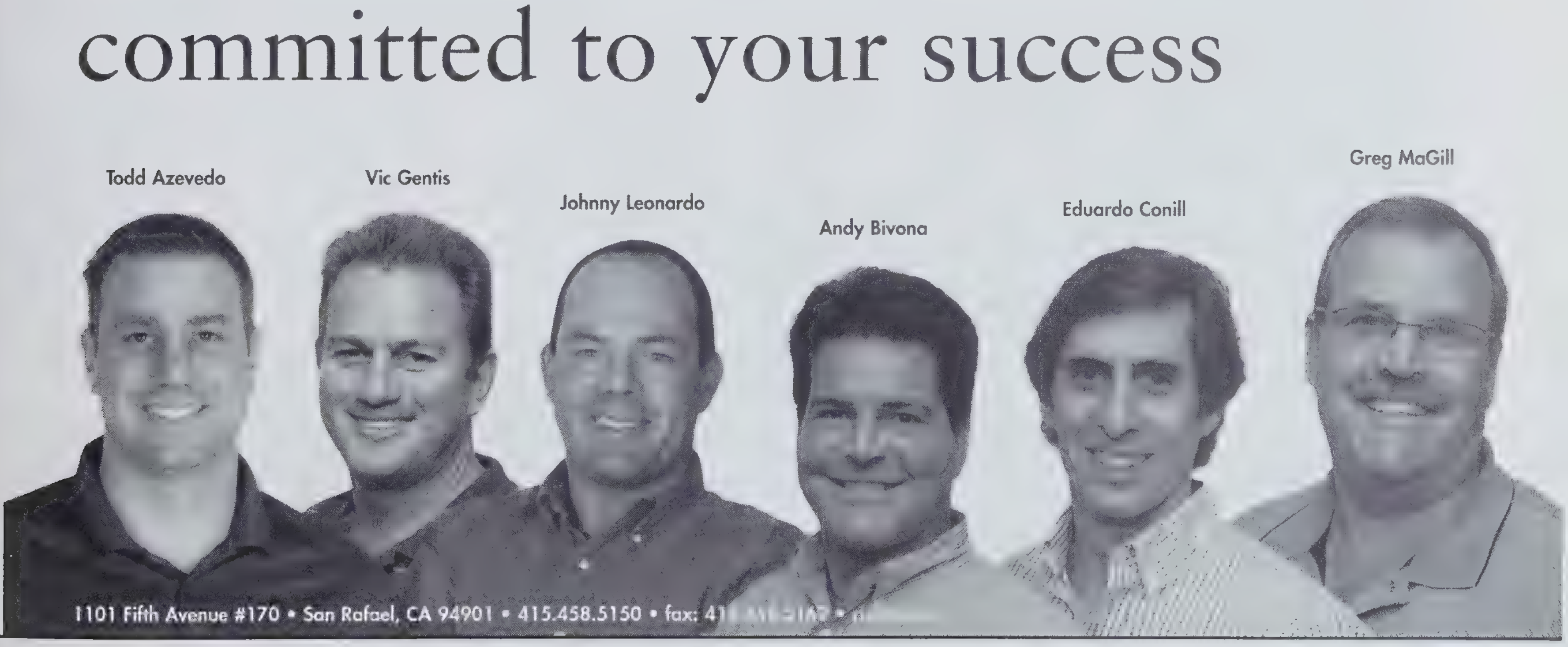

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CALIFORNIA

Clonal development of Chardonnay

BY Nancy L. Sweet,
Foundation Plant Services,
University of California, Davis

Foundation Plant Services

A large collection of Chardonnay selections is maintained by Foundation Plant Services (FPS) at the University of California (Davis, CA), most of which are available to the public. FPS selections include two main styles of the Chardonnay grape.

Traditional Chardonnay grape clusters are small to medium size and cylindrical with small and round berries with thin skins. Chardonnay often suffers from *millerandage*, whereby clusters contain both normal- and small-size berries, known as "hens and chicks" or "pumpkins and peas."[5,22]

The second style of Chardonnay differs from the traditional form in flavor profile. Clones known as Chardonnay *musqué* are an aromatic sub-variety of Chardonnay that has a slight muscat flavor, probably caused by an accumulation of monoterpenes during fruit maturation.[19]

A third Chardonnay form, a rare, pink mutant called Chardonnay rosé, is not available in the FPS collection.

California Chardonnay plant material in the post-WWII period, when the wine industry began developing the grape as a wine variety, had two primary sources — the Wente vineyard (Livermore) and the Paul Masson Vineyard (Santa Cruz Mountains). Distinct clonal lines emerged from two separate French sources of Chardonnay vines in the Wente vineyard with subtle morphological and biochemical differences.

Researchers have proven that clonal diversity within ancient winegrape cultivars such as Chardonnay has a genetic basis accounted for "by the differential accumulation of somatic mutations in different somatic lineages."[20]

Chardonnay is very adaptable to many climates and soils. Clonal variation results, over time, when plant material from the same source is dispersed to various climate and topographical regions throughout California. Several researchers have observed differences in Chardonnay clonal selections, mani-

Chardonnay FPS-04 (previously known as Clone 108).

Chardonnay FPS-66 is a "Mount Eden clone"—the plant material originated in Larry Hyde's Carneros vineyard.

fested in yield, vigor, fruit intensity and composition, and flavor profiles.[3,5]

Formal grape clonal selection programs in the U.S. have not received the financial support that has allowed European programs to progress. Despite this limitation, Dr. Harold Olmo (UC Davis) was able to make a great contribution to Chardonnay clonal selection in the late 1950s. He observed that Chardonnay plant material available in California, at that time, produced low yields with shot berries and suffered from viruses. Dr. Olmo attributed those qualities to the lack of interest by the California grape and wine industry.[18]

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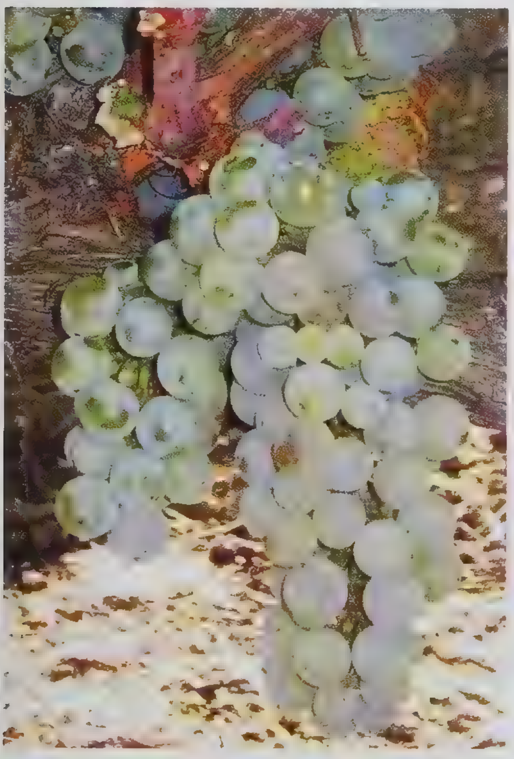

Chardonnay FPS-72 has under-size berries interspersed with normal-size grapes, also known as "hens and chicks."

Chardonnay trials were conducted at Louis Martini's Carneros vineyard and the University's Oakville vineyard in the 1950s and 1960s. Several selections were identified for virus elimination treatment in Dr. Austin Goheen's program at FPS and eventually became the most widely planted Chardonnay selections in California. The Olmo Chardonnay program increased the average yield from ½-ton per acre in the 1950s to more than five tons per acre.[5]

The "Wente clone" is pervasive in the Chardonnay story because many growers, and Dr. Olmo, obtained bud-

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wood, either directly or indirectly, from the Wente vineyard.

Philip Wente says, "The primary interest in obtaining wood from [the Wente] vineyard was that it had been continually selected by Ernest Wente for vines showing desirable traits and replicated in different new vineyard selections over 30 to 40 years. That wood was non-existent in the few other Chardonnay vineyards in California at the time. CDFA records report about 230 acres of Chardonnay in 1960, so there were most likely only a few growers … our records showed Wente with about 70 acres at that time."[25]

The term "Wente clone" can be confusing in that it has been used both for an older selection with small clusters that sometimes contain a high percentage of shot berries and for more productive FPS selections that can be traced back to the Wente Vineyard.[5] The "old Wente" clone is notable for its typical "hens and chicks" berry morphology and clonal variation in flavor and aroma.[2] Heat-treated UC selections developed from Wente vines do not exhibit the *millerandage* tendency.

Some of the clonal variants are known as Robert Young, Stony Hill, and Curtis clone(s). Chardonnay-*musqué* style Wente variants include Spring Mountain, See's, Sterling, and Rued.

At one time, FPS possessed plant material which originated directly from the Wente Livermore Vineyard. **Chardonnay FPS-03** came to FPS around 1963 with a source designation of "Wente 6 v18" and "Wente 10 v27," and was not heat-treated. This selection was planted in the Foundation vineyard (1964) and first appeared on the Registered list that year as Chardonnay FPS-03.

In 1965, the name was changed to **Chardonnay FPS-03A**. It disappeared from the Registered list in 1966 but was still distributed by FPS as late as 1968. Goheen wrote: "Chardonnay-3A was a selection from a commercial planting in Livermore Valley. It was abandoned in 1968 because it did not

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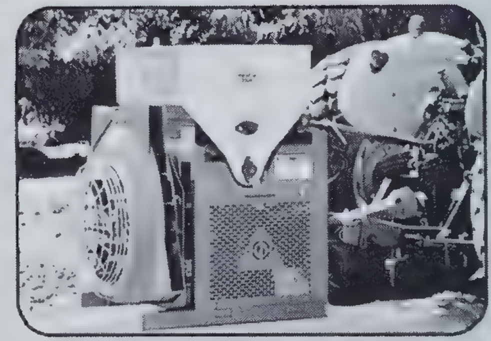
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set normal fruit [it had shot berries]."[10]

Among the first to propagate vineyards directly from the Wente vineyard were Fred and Eleanor McCrea, who harvested wood from the Livermore vineyard in 1948 for their new Stony Hill Vineyard above Napa Valley.[2,28] With the permission of Herman Wente, they took cuttings "at random" from many Chardonnay vines throughout the Wente vineyard. The McCreas were early pioneers in Chardonnay planting in California when there were less than 200 acres of Chardonnay planted.

In 1942, Louis Martini, Jr. purchased 200 acres of the Stanly Lane Ranch in Carneros and began clonal experimentation with several varieties including Chardonnay.[18,26] Martini selected 30 individual vines at Stony Hill and budded 20 grafts from each of the 30 vines onto St. George rootstock in 1951 or 1952.[18] He later allowed UC Davis to use these 600 vines for trials.[18]

Dr. Olmo began clonal selection of Chardonnay for the UC Davis collection in the early 1950s. His goals were to improve yield, eliminate the shot berry quality of many Chardonnays, and select against vines that appeared to be infected with virus.

After measuring vine yields and making small wine lots (in glass) from vines in the Martini vineyard for several years, Dr. Olmo made selections for the University's clonal propagation program from Stanly Lane vines beginning in 1955. This wood would become **Chardonnay FPS 04–08** and **14** ("Martini selections").[18]

Dr. Olmo then advanced three Martini selections (Olmo #68, #70, and #72) to field and wine trials at the UC Oakville Experimental Vineyard (1960 to 1966) for comparison to one clone obtained in Meursault, France (former FPS-02 and Olmo #812) and two clones from Alsace, France (Olmo #430 and #439). In the Oakville experiment, the Martini selections yielded as much as five tons, which

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was two to three tons per acre more than the French selections, which were abandoned by FPS.[10,18,27]

In 1964, the initial group of Martini selections, which were then identified by numbers given to them by Dr. Olmo (for example, Olmo #66 [FPS-04], #68 [FPS-06 and 08], and #69 [FPS-05]), were taken to FPS for heat-treatment to remove any virus.

Whether or not heat-treatment eliminated virus was not well-established then. Dr. Austin Goheen (USDA-ARS plant pathologist) explained in 1985: "Chardonnay became one of the first cultivars to test out the possibility of thermotherapy. We took the best appearing vines and heat-treated them. From the explants that we obtained, we indexed several lines. One line, which indexed disease-free and was easily recognizable as a good Chardonnay, was registered in the California Clean Stock program."[12]

Vines produced from single buds, that were heat-treated, were given unique selection numbers even if the buds were taken from the same original parent plant.

For example, FPS selections 06 and 08 were both propagated from the same source vine, designated Olmo #68, at the Stanly Lane property. Each of these so-called Martini selections was heat-treated for a different length of time. The heat-treated Martini Chardonnay selections released to the public through the California Registration & Certification (R&C) Program for Grapevines are also sometimes referred to as "heat-treated Wente clones."

CALIFORNIA AND WASHINGTON CLONES

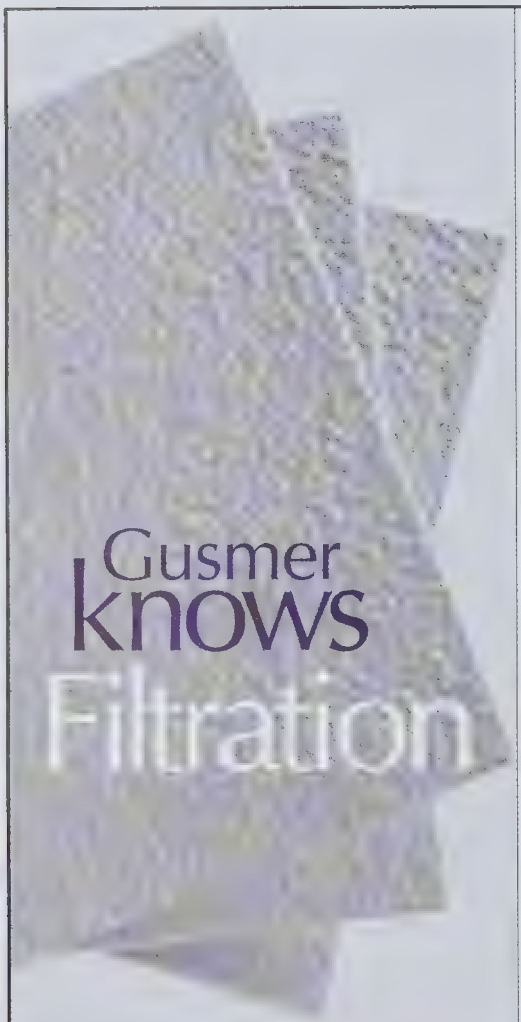
Chardonnay FPS-04 (formerly Olmo #66) and FPS-05 (formerly Olmo #69) were two selections brought to FPS by Dr. Olmo from the Martini Carneros vineyards. Both selections underwent heat-treatment for 90 days and were first registered in the California R&C Program for Grapevines in 1969.

In the 1960s (prior to when FPS selections 04 and 05 were released as registered plant material) Curtis Alley (UC Davis viticulture specialist), combined the two selections into what he called "clone 108" — most likely due to the fact that despite originating from separate mother vines, the two selections had undergone heat-treatment for the same length of time.

"Clone 108" was also variously called the "Davis clone" or the "Wente clone," and was distributed throughout the 1960s when it was used to plant most of Washington state's and half of Napa's Chardonnay.[2,11]

Wente Brothers was one of the early recipients of the heat-treated derivative of the old Wente clone for their new Monterey County vineyard. Philip Wente confirms that Wente Vineyards received wood from FPS location "G9 v5-6," which, in 1963, was known as clone-108 but later identified as FPS-04.

Wente planted clone-108 in the new increase block 36 at Arroyo Seco.



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Clone-108 was separated into FPS selections 04 and 05 in 1969 because the selections had originated with different vine sources.

Chardonnay FPS-06 and **08** (both formerly Olmo #68) were taken from the same vine (Martini vineyards). FPS-06 and FPS-08 received individual FPS selection numbers as they underwent heat-treatment for different lengths of time: 164 days and 114 days.

FPS-06 yielded over four tons per acre in the field trials conducted by Dr. Olmo in the late 1950s, making it the highest yielding selection of the Stanly Lane vines. Chardonnay FPS-06 and FPS-08 first appeared on the FPS Registered list in 1973.

Chardonnay FPS-09, 10, 11, 12 and **13** were all propagated from FPS-08 in the late 1960s. FPS-09 and 10 underwent heat-treatment for 102 days; FPS-11 and FPS-12 for 116 days; and FPS-13 for 144 days. They all first appeared on the FPS Registered list in 1973.

Chardonnay FPS-14 (formerly Olmo #65) came to FPS from the Martini Stanly Lane vineyard via UC Davis' West Armstrong tract in the late 1960s. It was subjected to heat-treatment (111 days) and first appeared on the Registered list in 1974.

Although widely planted on the west coast, the "Davis clones" have been criticized by some winemakers who feel that a healthy yield is at odds with production of high-quality wine. Others believe that the Davis plant material such as "clone 108" is desirable if a crop is controlled to a maximum yield of three to four tons per acre.[2]

The following statement appeared in *Wine & Spirits* in April 1994: "The Chardonnay clones selected and developed for the industry in the 1970s by Dr. Harold Olmo and his UC Davis colleagues, particularly the dependable, high-yield clone #108, accomplished the goal of making Chardonnay commercially viable in California. By raising the basic level of quality, Dr. Olmo's work conferred the freedom to pursue a more elusive aesthetic ideal. For years, that pursuit was conducted furtively with suitcase clones smuggled in from France and propagated on the sly, unfortunately with their viral diseases and other problems intact."[23]

In contrast, Bill Knuttel (Chalk Hill Vineyards & Winery, Healdsburg, CA, winemaker, 1996–2003), was quoted on Chardonnay-04: "Growers should not forego any of the clones that have been in use, especially FPMS-4 … [which] is more subject to vintage variation than some other clones, especially because of yield, but with the right site and vintage conditions, it normally produces healthy yields and good wine. Many of the great Chardonnays of 1994 and 1995 had clone-4 as a base."[24]

FPS "Martini" selections (FPS-04, 05, 06, 08, 14) and their propagative offspring (FPS 09-13) have undergone field trials to assess performance in

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various California climate zones. FPS-04 and 05 have been the workhorses since they were initially distributed together as "clone 108." Either FPS-04 or 05 is invariably included in every California study of Chardonnay selections.

UC Davis researchers conducted field trials at Jaeger Vineyards and Beringer Vineyards in Napa Valley (1989–1991) to evaluate clonal differences among six certified virus-tested FPS selections (FPS-04, 05, 06, 14, 15, 16). Only clones testing virus-free were used to ensure that observed differences were genetic and not due to virus status.

Both FPS-04 and 05 had characteristic high yields with many heavy clusters with high numbers of moderately heavy berries. FPS-06 yielded more but lighter clusters, with fewer berries per cluster than FPS-04 and 05. FPS-06 and 15 (discussed below) exhibited the greatest pruning weights at both sites.[27]

Field performance of the same six FPS Chardonnays plus FPS-09 was assessed in the Salinas Valley in 1994–1996, with similar results to the Napa trials. FPS-06 and 09 originated from the same plant material in the Martini Stanly Lane vineyard (Olmo #68) but underwent heat-treatment for different lengths of time.[3]

FPS-04 and 05 showed the highest yields, attributable to higher cluster weights, large berry size and weights, and more berries per cluster. Titratable acidity was highest and pH lowest for selections 04 and 05; the later maturity of these selections had also been observed in prior experiments. This tendency to later maturity has ripening implications for cool climate areas with short growing seasons.[3]

Pruning weights were highest for FPS-06, 09, and 15, which was similar to the Napa trials. Those three selections were in a group with intermediate yields, fewer berries and clusters, and lower berry weights than selections FPS-04 and 05. FPS-06 and 09 showed modest yields with more small clusters per vine.

However, no significant differences in yield, growth, or other experimental parameter were detected for FPS-06 and 09, leading researchers to conclude that the different heat-treatment periods imposed on the two selections from the same source-vine did not influence vine performance.[3]

Heavy clusters driving the high yields exhibited by FPS-04 and 05 in the cool-climate trials could be problematic in warmer climate regions of California where large tight clusters could suffer more sour rot than smaller or lighter clusters. Approximately 7% of the state's Chardonnay is grown in San Joaquin Valley.[8]

Researchers in Fresno County evaluated the performance of FPS-04, 06, and 15, along with two Italian clones and one French clone (discussed below) for performance in a warm climate. Data from 2000–2003 revealed a "strikingly signifi-

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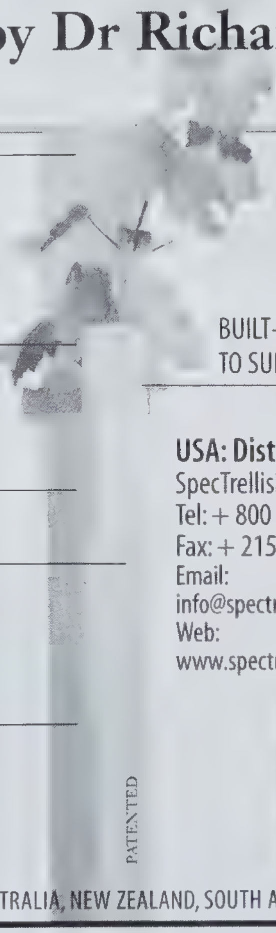
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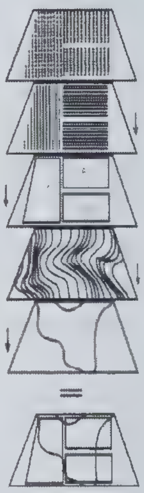
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cant," more so than Napa and Salinas, year/clone interaction for yield components for FPS-04 and 15.

In three of four years, FPS-04 showed the fewest and heaviest clusters; due to more berries per cluster. Researchers rated FPS-04 fruit as having the most desirable fruit composition of the clones tested, with higher Brix, lower pH, and higher titratable acidity. A long growing season in a warm climate region favors grapes in this late-maturing selection.

However, FPS-04 and two others (FPS-20 and 37) had the highest incidence of susceptibility to sour rot. That trait is a major disadvantage for FPS-04 when grown in the California Central Valley. The researchers ultimately recommended that growers in that region consider FPS-15 rather than FPS-04 due to low bunch rot potential.[8]

Chardonnay FPS-15 was sent to UC Davis in 1969 by Dr. Walter Clore, of the Irrigated Agriculture Research & Extension Station (IAREC) in Prosser, WA. Dr. Clore, "the father of Washington Wine," was a horticulturalist associated with Washington State University's Prosser Experiment Station for 40 years.

Dr. Clore presided over field and wine trials for 250 grape varieties, including Chardonnay, and was primarily responsible for convincing Washington growers that premium wines could be made from *vinifera* grapes grown in eastern Washington. Dr. Clore planted variety blocks at Prosser beginning in the late 1930s using *vinifera* material that he and his mentor, W.B. Bridgman (Sunnyside farmer winery owner), imported from Europe and California growers.[6,15]

FPS-15 has been known in Washington state as "the Prosser clone." Other than a location designation "Prosser LR 2v6," the origin of Chardonnay FPS-15 is not clear. The Clore variety blocks at Prosser were split into high and low sections. FPS-15 was from row-2 vine-6 of the low

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section variety block that underwent heat-treatment at UC Davis for 173 days and has since tested negative for viruses. FPS-15 was registered in the California R&C Program for Grapevines in 1974 and has been one of the most requested Chardonnay selections in the past five years.

A 1½-acre variety trial was established at the IAREC vineyard in 1965 using premium wine grapes including Chardonnay. Analysis of the experiment does not report a source for Chardonnay vines planted in the trial but does indicate that the material was known to be virused. Data on yields and fruit composition were reported for 1967–1970.

The Chardonnay in the trial was one of the lowest yielding varieties (3.78 to 5.59 tons per acre), and had loose clusters and an excessive amount of shot berries. It was infected with leafroll virus. Grape maturity and fruit analysis for the four-year period of the trials varied from: 21.3° Brix to 23.1°, which was within the range of FPS-15 in Fresno (22.8°) and Salinas (23.2°); 0.76 to 1.03 titratable acidity, which was higher than Fresno (0.58) and Salinas (0.65); and pH (3.20 to 3.43), which was lower than Fresno (3.7) and Salinas (3.61).[7]

The grape morphology, timing of the Washington IAREC trial, and the fact that the Chardonnay in the trial was virus-infected suggest that this Chardonnay was the clone that eventually became FPS-15.

FPS-15 has been evaluated in numerous California field and wine trials. In addition to the trials mentioned above, Larry Bettiga (UC Cooperative Extension Specialist) began a second trial in Monterey County (1995) near Greenfield. FPS-05 and 15 were used as standards to compare with some French and Italian clones.[4] FPS-15 was also included in the Chalk Hill trial, begun in 1989. FPS-15 produced relatively low to moderate yields in all trials.

Yields for the trials in the cooler growing areas were:

County	Vineyard	kg/ vine	Information Source
Napa	Jaeger/Beringer	9.3	Wolpert *et al.* 1994
Sonoma	Chalk Hill	4.94–8.12	Heald & Heald 1999
Monterey	Salinas/Zabala	3.83	Bettiga 2003
Monterey	Salinas/Pacific	6.79	Bettiga 2002

In the Fresno County trial, FPS-15 yielded an average of 19.9 kg/vine for the four-year period, which was the lowest of six selections tested. FPS-15 experienced erratic fruit yield over the years as indicated by significant year/clone interaction in some trials. Lower yields were also attributed to lower cluster weights due to smaller and fewer berries per cluster.

A large number of shot berries was reported in all trials except for Fresno.

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In summary, although FPS-15 demonstrated high vine vigor in the trials, it produced lower yields due to higher numbers of smaller, loose clusters.

Fresno and Sonoma/Chalk Hill researchers found FPS-15 to be "sour-rot resistant" and "rot-resistant," respectively. Fresno researchers found 70% to 90% fewer clusters with sour rot in FPS-15 than with other selections tested. The cluster morphology and sour-rot resistance led them to recommend FPS-15 for warm Central Valley growing areas.[8]

FPS-15 has received good marks for fruit composition in some trials. Fresno researchers concluded that FPS-15 had acceptable fruit quality due to low soluble solids and high titratable acidity. In Simi Winery trials (early 1990s), it was concluded that FPS-15 had a great "intensity" of fruity flavor, which could be excellent for blends.[28]

Chalk Hill Winery researchers found FPS-15 to be one of the five most preferred clones in the wine tasting category of the trials due to consistently high-quality wine produced over the years; FPS-15 was advanced to further trials at Chalk Hill.[13,24] The researchers concluded: "[FPS-15] is projected to be ideal for cool climates and Reserve Chardonnay programs."[13]

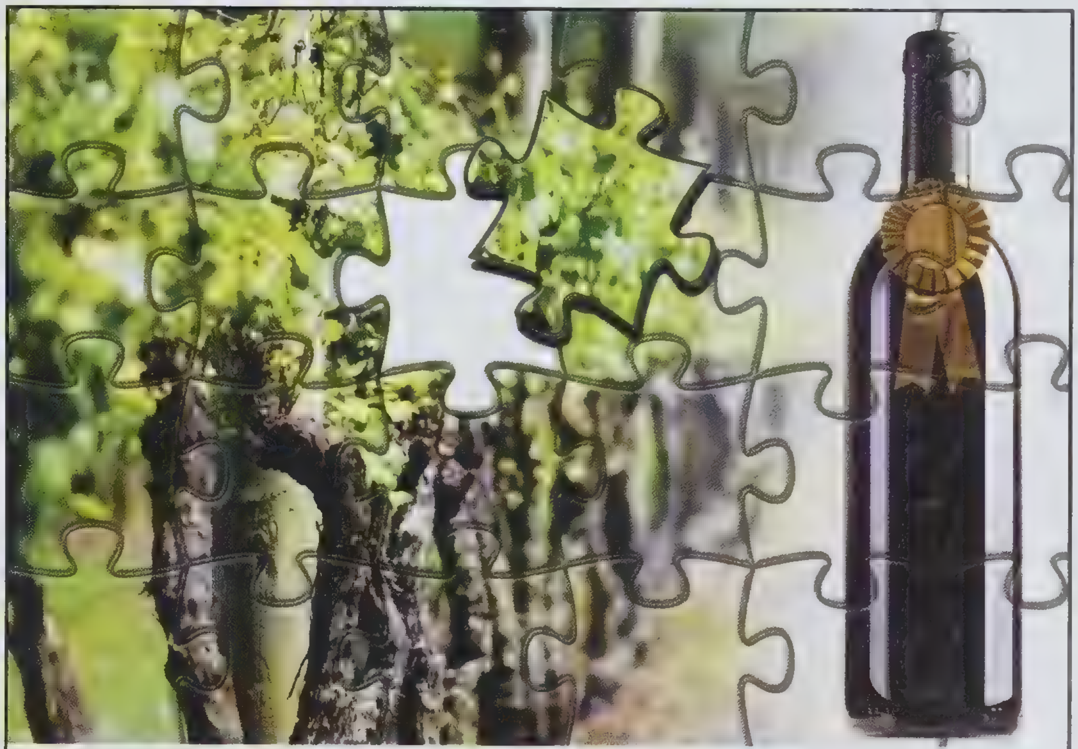
The popular **Chardonnay FPS-17** came from the Robert Young Vineyard (Alexander Valley). Its original source vines have often been referred to as "the Robert Young clone" which was planted with budwood brought from the Wente Vineyard (Livermore) in the 1960s.[2] FPS-17, a proprietary selection held for Robert Young Vineyards, underwent heat-treatment in Davis (1982) and first appeared on the FPS Registered list in 1987.

FPS-17 was included in the Chalk Hill trials in Sonoma County. The 1996 harvest showed that FPS-17 had a moderate yield of 6.5 tons per acre — higher yielding and with larger clusters than FPS-15. FPS-17 had many small, shot berries and some rot resistance. The researchers concluded that it might be suitable for cool climate areas and rot-prone sites.

Data taken over a four-year period showed the following ranges for FPS-17: 22.4° to 23.3° Brix, 3.30 to 3.44 pH, and low titratable acidity 5.7 to 7.9. FPS-17 was considered one of the most promising selections because it consistently produced high quality wines over the years.[13,24]

Chardonnay FPS-72 was generously donated to the FPS public collection by the Wente family from a production block in the Arroyo Seco appellation that has provided Chardonnay plant material to many California growers. That plant material was once known in California as FPS-02A.

The origin of **Chardonnay FPS-02A** began in the 1930s at UC Davis. Chardonnay FPS-1 was planted in 1956 in one of the first Foundation vineyards in Davis, described in the 1956 Registered List as "vineyard at the



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intersection of S.P. R.R. and U.S. 40 in the old Agronomy field."

The source listed for Chardonnay-1 on FPS records, "I 57-12, UCD," is a field location for a Chardonnay vine shown in very old Olmo maps of the Department of Viticulture & Enology's Armstrong Vineyard Block "I." Its history can be traced on old maps back to a source called D3: 19-21, which was a block location in the Armstrong Vineyard in 1930.

There was no further evidence in UC Davis records as to the source of I 57 v12 / D3: 19-21. The oral tradition passed down through three Wente family generations indicates that Chardonnay-02A originated as a result of vineyard selection efforts by the Wentes.[25]

FPS distribution records show that the plant material described as Chardonnay-1 in the 1956 Registered list was distributed to FPS customers until 1961 (FPS Distribution Records, 1956–1961). When a new Foundation vineyard was created around 1961, plant material was taken from the old Chardonnay-1 in order to do a heat-treatment on it and release it under a different selection number. Chardonnay-1 disappeared from the Registered list in 1963 and was removed from the Foundation vineyard in 1967.

Plant material taken from Chardonnay-1 underwent 102 days of heat-treatment in 1961-1962. The new selection was renumbered FPS-02A and planted in a new Foundation vineyard in 1964 (FPS Indexing Records). FPS-02A was first distributed by FPS to customers in 1966.

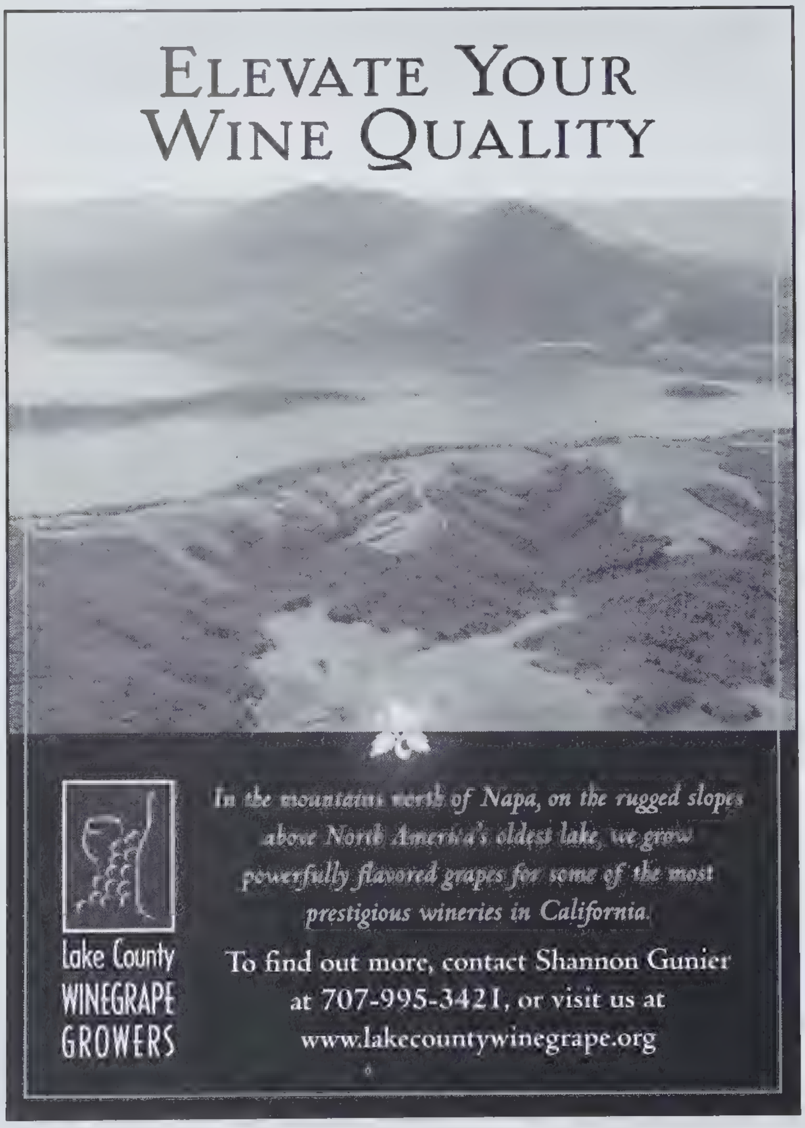
Records from both FPS and Wente Vineyards show that 19 budsticks of FPS-02A were sent to Wente Vineyards in 1966.[6,25] The Wente records show that the wood from those budsticks was planted in a production block near Greenfield in Monterey County. Wente Vineyards distributed wood from that production block to many growers throughout California.[2]

FPS distributed FPS-02A to individual customers, wineries, and nurseries until 1967. In 1968, it was removed from the list of registered vines, and pulled out of the Foundation vineyard because of leafroll-positive status in 1969.

FPS-02A resembles the "Wente clone" that was described above as the "older clone" with small clusters and shot berries. Dr. Jim Wolpert (UC Davis Department of Viticulture & Enology) describes the vines as clean (no obvious virus symptoms on the leaves), with uniform production and small clusters with frequent "hens and chicks" morphology (*millenderage*).

Ralph Riva (Wente vineyard viticulturalist), indicates that this grape material produces four main flavor components — apple, muscat, pineapple, and fruit cocktail — which results in a very good Chardonnay.[21]

Despite the fact that FPS-02A had become a popular and widely-used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"clone" in California, FPS no longer had any of that selection growing in the Foundation block after 1969. Around 1991, Riva and Dr. Wolpert collaborated to return FPS-02A plant material to FPS. Riva brought a large amount of FPS-02A wood from a single vine to FPS that underwent shoot-tip tissue-culture treatment for virus elimination and first appeared on the FPS Registered list in 2002 as FPS-72.

Robert Mondavi Vineyards made two of its Chardonnay selections available through FPS. Mondavi's version of the Wente clone, **Chardonnay FPS-67,** arrived at FPS in 1995 as a proprietary selection. It underwent tissue-culture treatment for virus elimination and first appeared on the FPS Registered list in 2002.

Chardonnay FPS-106 came to FPS in 1998 as a proprietary selection from Mondavi's Byron Vineyards (Santa Barbara County). It underwent tissue-culture treatment and first appeared on the FPS Registered list in 2005. Both Mondavi selections were released to the FPS public collection in 2006.

Chardonnay FPS-79 and **80** came to FPS in 1996 from Sterling Vineyards in Napa Valley. FPS Director Deborah Golino collected plant material from one Sterling vineyard. The selections, described as Heritage Sterling muscat clone-1 and 3, consist of two Chardonnay *musqué*-type clones that were favored by both the winemaker and viticulturist and believed to possess unique qualities. Both selections tested positive for virus and underwent shoot-tip tissue-culture treatment and first appeared on the FPS Registered list in 2002.

Chardonnay FPS-97 is a proprietary Chardonnay selection held at FPS for Chalk Hill Estate Vineyards & Winery. The selection originated from a vineyard planted in 1974 and exhibits cluster morphology similar to an "old Wente" field selection with loose clusters with many small shot berries. For that reason, Chalk Hill refers to it as the "Shot Berry clone."[13] Chalk Hill viticulturist Mark Lingenfelder reports, "Chalk Hill Winery still farms 13 acres of that original block planted in 1974 and it continues to be one of our best blocks in terms of wine quality."[16]

FPS-97 came to FPS with virus in 1996 and underwent shoot-tip tissue-culture treatment. It first appeared on the FPS Registered list in 2003. Chalk Hill has recently incorporated FPS-97 into its ongoing clonal trials begun in 1996 and planned to make a separate wine from the vines in 2007 in order to compare selection FPS-97 wine attributes to 16 other clones in the trial.

Chardonnay FPS-102 was donated to the FPS public collection in 1997 by Kendall-Jackson Vineyards. The "Z clone" originated in Sonoma County and was described as an aromatic (muscat-type) Chardonnay similar to the Rued or Spring Mountain clones. FPS-102 underwent shoot-tip tissue-culture procedures for virus elimina-

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tion and first appeared on the FPS Registered list in 2003.

A group of Chardonnay clones donated to the FPS public collection in 2002 promises additional clonal variety with aromatic overtones in Wente clone material.

Larry Hyde (Napa grape grower who has developed several Chardonnay clones over the years), made six clones available to the public through FPS and the California R&C Program for Grapevines. The 130-acre Hyde vineyard in the Carneros region supplies grapes from these and other clones to more than 12 wineries, often resulting in high-quality wines. The six selections are undergoing virus-elimination treatment at FPS and may be available for release to the public in 2012.

One of these six Chardonnay selections is the "Hyde clone" (FPS group #7244) and comes from a 20-year-old block. [Selection numbers are only assigned when a selection has tested negative for virus and has been placed in the R&C program.] The Hyde clone suffers from corky bark virus, which Hyde now accommodates by growing it on St. George rootstock. The clone is productive with high acidity. Hyde explains that the grapes yield an unusual and unique complex flavor profile, characterized by "nutmeg as young wine, followed by a peach-like fruit flavor in one or two months."[14]

Additional clones donated by Hyde to FPS are Wente-like Chardonnays which he believes are each unique in terms of flavor profile. Hyde obtained two selections (FPS groups #7245 and #7246) from the former Linda Vista Nursery and characterizes them as "clean and heat-treated" Wente selections.

One Linda Vista selection (#7245) has small clusters and poor set, and #7246 has been a favorite of some winemakers due to small clusters of flavorful small berries. The fourth selection (group #7247) came from the Wente Livermore vineyard. The fifth selection (#7008) is labelled as the Calera clone.

The sixth selection in the Hyde group (FPS group #7248) is an aromatic (muscat) grape obtained by Hyde from Long Vineyards (Napa Valley). Zelma Long notes that the Long Vineyard was planted above Lake Hennessey in Napa Valley (1966-1967), using a massal selection that the budder, Rudi Rossi, said was collected from the Martini Vineyards. Hyde took cuttings from the Long Vineyard for the material currently at FPS.

Long, who made wine for Simi Winery from Hyde's Long Vineyard selection, and made wine at Long Vineyard itself, reports the two groups of wines show different character. A grape sensory analysis conducted at Long Vineyards showed five different flavor expressions in those grapes — yellow apple, citrus, spicy apple (nutmeg and ripe apple), white fruit (pear), and muscat (with citrus overlay) — each occurring in a different percentage in the vineyard, with the yellow apple and the citrus being the most common.[17]

Part II (May/June) will discuss French clones, Italian clones, and other foreign clones.

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18 KEY AREAS

SAFE Tractor Operation

Tractor safety is vitally important during harvest and anytime during the year. Encourage your family and employees to take time to review safety information for your equipment for a safe harvest and year-round operation. Below are a few tips from Kubota Tractor Corporation to help ensure safe tractor operation.

Know your tractor and implements — Be thoroughly familiar with the operator's manual(s) for your tractor and any implements before starting up the equipment. Know each control, its location, and how it works. Know how to stop the tractor and all implements quickly in the event of an emergency.

ROPS and safety belts — Many tractor accidents are overturns. They are usually caused by inappropriate speed, inappropriate use, terrain, inattention, lack of proper ballast, or a combination of these. The use of rollover protective structures (ROPS) and fastened seatbelts has saved many lives. ROPS generally will limit a side overturn to 90 degrees and will provide an important safety zone for the operator provided the operator is wearing the seat belt.

If you own or use an older model tractor, regardless of make or age, ask your tractor dealer about retrofitting a ROPS and make sure your tractor has this important safety device.

Additional safety items — Consider outfitting your equipment with a first aid kit, a small tool kit for minor repairs, and a fire extinguisher. Be sure these items are within easy reach and are securely fastened down.

Safety labels — Read and follow the messages safety labels provide to protect yourself and others. In particular, be familiar with the "Safety Alert" symbols: "Danger," "Warning," and "Caution." Keep safety labels clean and free from obstructing material. Replace damaged or missing labels with new ones. If a component with a safety label is replaced, make sure a new safety label is attached in the same location on the new part.

Dress properly — Close-fitting, belted clothing is a must. Flared pants, hanging shirt tails, scarves, and other loose clothing are too easily (and too often) caught in moving parts or controls. Further protect yourself from this hazard of entanglement by wearing long hair under a hat or net and by not wearing jewelry. Invest in sturdy, safety work shoes or boots with non-skid soles and steel toe caps; wear eye and hearing protection as appropriate or required. Protect yourself from the sun in summer and the cold in winter. Take extra care with cold weather and rain gear. Heavy work gloves are a plus. Safety goggles or sunglasses with shatter-proof lenses, noted by the indicator "ANSI 287.1" on the frame are essential for eye protection.

Check the work area — Know in advance where hidden obstacles, such as ditches, large rocks, stumps or any other debris, are located. Be wary of tall grass — it can cover hazards. Walk the area first to be sure. Make sure the area is clear of children and animals.

Who is the operator? — Pay particular attention to who operates the tractor. For example, someone with a short attention span and a tendency to be irresponsible or people who are tired are not good candidates.

Be sure the operator reads and understands the operator's manual(s), is familiar with the tractor, and is fully aware of his or her responsibilities. Have young operators take the 4-H or FFA Tractor Program for new operators. Be aware of your own responsibilities under OSHA regulations and local laws relating to tractors and tractor operation.

Maintenance is a must — Daily maintenance is the best way to keep your tractor in top running condition, and a well-maintained tractor is a safer tractor. Maintenance is not something to put off until tomorrow. Guided by your operator's manual(s) and your dealer, set up a maintenance routine and follow it.

Use only the correct fuel and never fuel your tractor while it is running or hot. Turn off the engine and let it cool. Wipe off the area around the fuel cap both before and after fueling. Do not smoke while handling fuel.

If diesel fuel is spilled on your hands or skin, wash it off right away to avoid skin irritation and to prevent your hands from slipping on the tractor controls when you drive off.

Before operating the tractor, visually check for oil leaks on the engine, transmission, and axles. Correct such leaks as soon as possible. Also, hydraulic and diesel fuel leaks can occur under high pressure; these require special care and attention. Use a piece of cardboard or wood to locate suspected high-pressure leaks — DO NOT USE YOUR HANDS! Hydraulic fluid or diesel fuel under high pressure can penetrate the skin, causing very serious injury and allergic reaction. For your safety, repair hydraulic and diesel fuel leaks immediately.

No riders — A tractor has only one seat — for the operator. There is no safe place for anyone else to ride, either on the tractor itself or on any of its implements. Make "NO RIDERS!" a firm, unbreakable, no-exceptions rule.

Children — Tragedy can occur if the operator is not alert to the presence of children. Children are generally attracted to tractors and the work they do. Never assume that children will remain where you last saw them. Keep children out of the work area and

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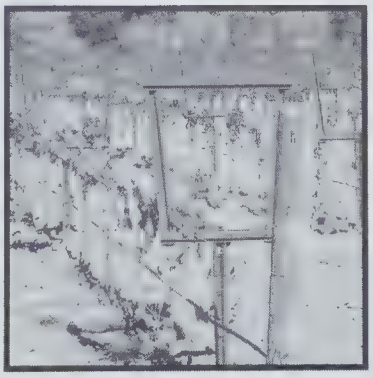

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under the watchful eye of another responsible adult.

Be alert and shut your tractor down if children enter the work area. Never carry children on your tractor. There is no safe place for them to ride. They may fall off and be run over or interfere with your control of the machine.

Never allow children to operate the tractor, even under adult supervision. Never allow children to play on the tractor or implement. Use extra caution when backing up, look behind and down — making sure area is clear before moving.

Start up — Follow your operator's manual. It contains start-up procedures. Do not start the engine by shorting across starter terminals or bypassing safety start switches. The machine may start in gear and move if normal starting circuitry is bypassed. DO NOT IMPROVISE!

If your battery is dead and requires the use of jumper cables or needs recharging, there is the potential for an explosion and injury from acid burns if safe procedures are not followed. Follow instructions provided in the operator's manual(s).

Never start or run the engine in a shed or garage unless the door is wide open and the area well-ventilated (carbon monoxide is colorless, odorless, and deadly).

Don't ever start the engine from anywhere other than the seat. You must be firmly seated, with your seat belt buckled (if your tractor is equipped with ROPS), parking brake(s) on, clutch pedal fully depressed, all controls in neutral, and the immediate area clear of children, pets, and livestock.

Before driving off, check all gauges, warning lights, and controls, and listen for any unusual noises. Be sure the implement/attachment is in the proper transport position before shifting into gear.

Speed — Always keep in mind that a tractor is a workhorse, not a racehorse. It must be operated at a safe speed. Be especially careful going to and from the field or work area — many tractor accidents happen during that trip. Never be in a hurry. To help assure straight-line stops when driving at transport speeds, lock brake pedals together.

Hillsides — Use special caution on slopes and uneven ground. Drive at a speed slow enough to maintain complete control of the tractor at all times. Don't depress the clutch pedal or attempt to shift gears while going up or down a slope. If you have to go up a slope, it is best to back up. Be sure that your tractor is properly counterweighted. Generally, if you feel uneasy about what you are doing with your tractor, **stop doing it.**

Stormy weather — In rainy weather, stay alert for holes or ditches

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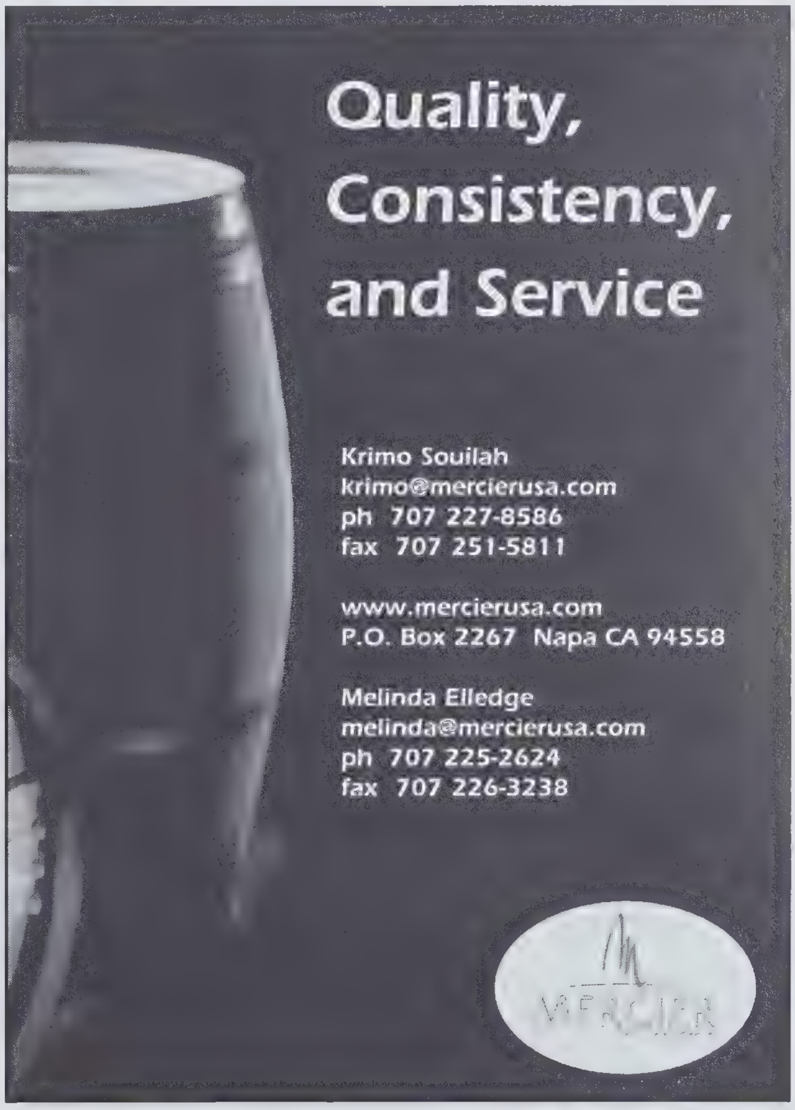

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hidden under water. Cut your speed to the minimum. If there is a thunderstorm, stop. Get off the tractor. Stay away from large trees, power lines, etc., and go indoors if possible. In icy conditions, use extreme caution. Use tire chains and wheel weights. Again, drive at a speed slow enough that you can maintain complete control of the tractor at all times.

Drawbar hitch — Hitch only to the drawbar when pulling a load. The drawbar is the only safe place for any kind of pulling or towing. Hitching to the axle or top link bracket can cause the tractor to flip over backwards very quickly. Be sure no loose chains, ropes, or cables are dangling or dragging from either the tractor or the implement. They can catch under a wheel, on a stump, or on a rock, and cause a serious or fatal accident.

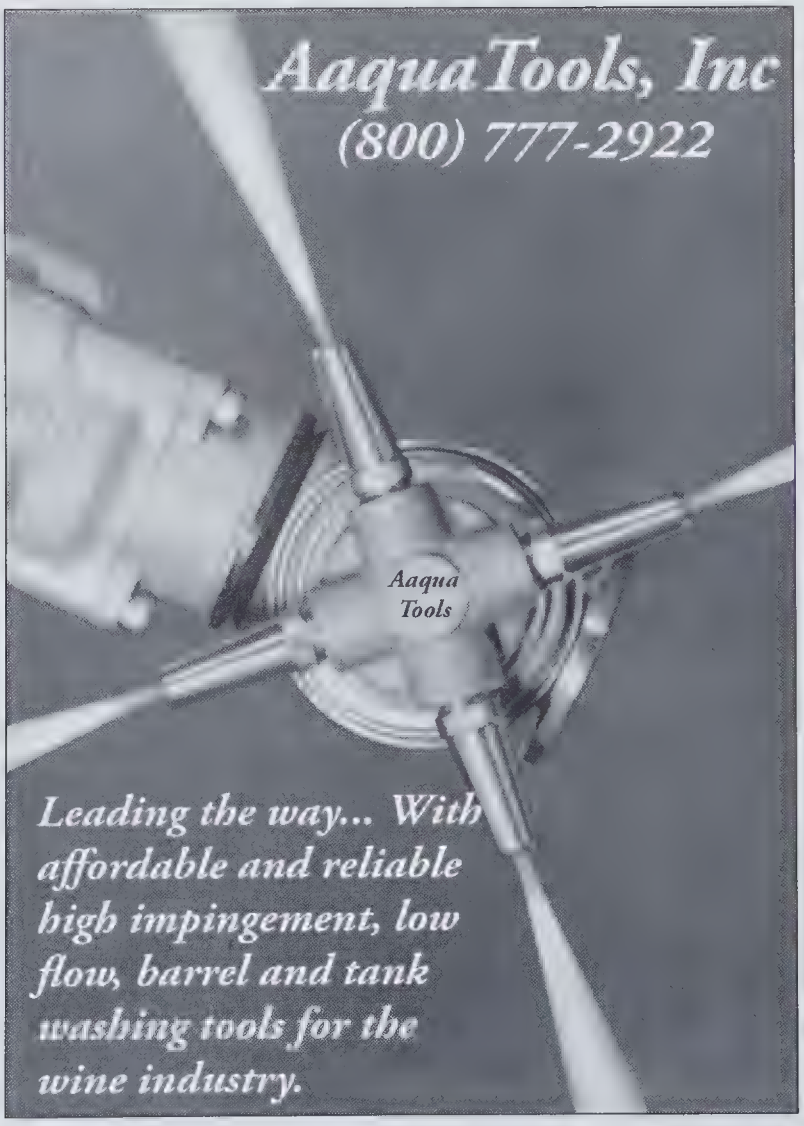
Power take-off — An operating power take-off (PTO) can be the most dangerous part of your tractor, which is why extra caution is necessary. Always keep the protection shields in place. An unguarded rotating shaft is very powerful and can entangle your clothes, causing serious or fatal injury, at a rate too fast to be stopped in time. Never work around rotating parts. Shut the tractor down, remove the key, and wait for everything to stop turning before entering the PTO area.

Transport operations — Although tractors are not generally made for public roads, there are times when such travel cannot be avoided. Please remember that your tractor/ implement combination can be large, heavy, and relatively cumbersome. The average motorist is not expecting to encounter such a vehicle on the road. With that in mind, and before you move your tractor and attachments over public roads, consider your route. Be sure you are familiar with all local regulations.

Use a slow moving vehicle (SMV) sign, proper clearance flags, lights, and warning signals. Use an escort vehicle as appropriate or required for additional safety. Be sure the brake pedals are locked together and properly adjusted to assure straight-line stops.

Prepare your attachments. Make sure they are secure, properly mounted, and the tractor is properly counter-weighted. Carry attachments in the transport position. Remove or cover sharp projections. Never operate attachments during transport. Keep the PTO lever in neutral.

Safe driving on the road is a must, and a safe driver is a courteous driver. Slow down, pull over, and let the normal traffic pass you. Be extremely careful at intersections. Remember, your tractor is not capable of fast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starts, fast stops, or quick acceleration. When you approach a traffic light, adjust your speed to ensure the maximum time available for safe crossing and to minimize the need for stopping, particularly on a steep hill.

Control your speed. A tractor is designed for easy maneuverability at low speeds, not at high speeds. A tractor's steering reacts quickly, especially in high gear, so keep both hands on the wheel. According to the National Safety Council, about one-third of all fatal tractor accidents occur on public roads, so be very careful.

Slow down on turns or curves. A tractor's center of gravity is generally higher than that of most automobiles and taking a sharp curve too fast can more easily result in an overturn. Slow down if you are pulling a heavy load on the highway. You have only

Kubota encourages safe tractor operation and Roll-Over Protection Structure

Kubota encourages families and businesses to take time to review safety information for your equipment. Be sure that older tractors and equipment have a Rollover Protection Structure (ROPS) and a seatbelt to provide a protective zone around the operator if a rollover should occur.

Kubota has provided ROPS as standard equipment since 1985 — even before federal law required manufacturers to include ROPS on new tractors. Owners of early Kubota models can obtain a ROPS and safety belt retrofit to their tractors by contacting their local Kubota dealer.

"We strongly recommend the use of a ROPS and a seat belt. A ROPS and fastened seat belt provide a safety zone that may reduce chances of serious injury in the case of a rollover accident," says Greg Embury, vice president of sales and marketing, Kubota Tractor Corporation. "Kubota has a long history of helping to bring safety to the forefront by carefully engineering products with operator safety in mind, and by encouraging people to familiarize themselves with their equipment and its safe operation."

Kubota dealers, throughout the U.S., have installed more than 10,000 ROPS retrofits. According to the National Safety Council (NSC), if all tractors were equipped with a ROPS and a seatbelt, about 350 lives would be saved each year.

Kubota Tractor Corporation, Torrance, CA, is the U.S. marketer and distributor of Kubota-branded equipment, including a complete line of tractors up to 103 PTO hp, performance-matched implements, compact and utility-class construction equipment, and utility vehicles. For product literature or dealer locations, contact Kubota Tractor Corporation at 3401 Del Amo Blvd., Torrance, CA 90503, (888) 4-KUBOTA [888/458-2682], Ext. 900, or visit www.kubota.com.

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Bel Air tonnellerie

two brakes — one on each rear wheel* — and the load may have no brakes at all.

Have the tractor in the same gear going downhill as you would to go up, in order to use engine compression for braking. Never coast downhill. This is a very dangerous practice. It will allow the tractor speed to exceed that for which it was designed.

Know your stopping distance. Always leave enough room to stop.

Never use the differential lock while in transport, because the tractor will tend to continue in a straight line when you are attempting to turn.

Most states require that an SMV (slow moving vehicle) sign be placed on the rear of any tractor or its towed attachment when traveling 25 mph or slower. The sign, a fluorescent yellow-orange triangle with a dark red reflective border, should be centered and two to six feet above ground.

If at all possible, public-road driving should be done in the daytime and during the lightest traffic hours. The best and safest rule is not to drive on any public road at night.

If it becomes necessary, however, be sure you are completely in compliance with your state and local laws concerning lights — white for the front and red for the rear. There should also be an amber or red light on the farthest projection to the left (the traffic) side, whether it's the tractor or the attachment. If you have to stop at night, pull completely off the road and set up flares or reflectors.

Stay off the shoulders when possible. If you must drive on the shoulder, reduce your speed and keep a sharp eye out for rocks, holes, soft spots, side rails, slopes and other hazards.

Shut down — When you shut down your tractor for one reason or another, put the PTO lever in neutral and lower attachments to the ground. Shut off the engine and set the parking brake(s). Remove the key from the ignition and lock the cab door (if equipped).

Whenever possible, park on level ground. If it is necessary to park on a grade, position the tractor at right angles to the slope and chock the wheels securely.

Do not jump off the tractor. Use the steps and handholds, face towards the tractor, and watch your step. (The steps should be cleaned regularly and kept free of dirt, grease, and oil. A slippery step is an invitation to a fall.) ■

Article provided by Kubota Tractor Corp. For more information, visit www.kubota.com.

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* Four-wheel drive tractors behave and brake differently than two-wheel drive tractors. Some tractors have full-time, four-wheel braking when both pedals are pressed together. Familiarize yourself with these differences and use unfamiliar tractors carefully.

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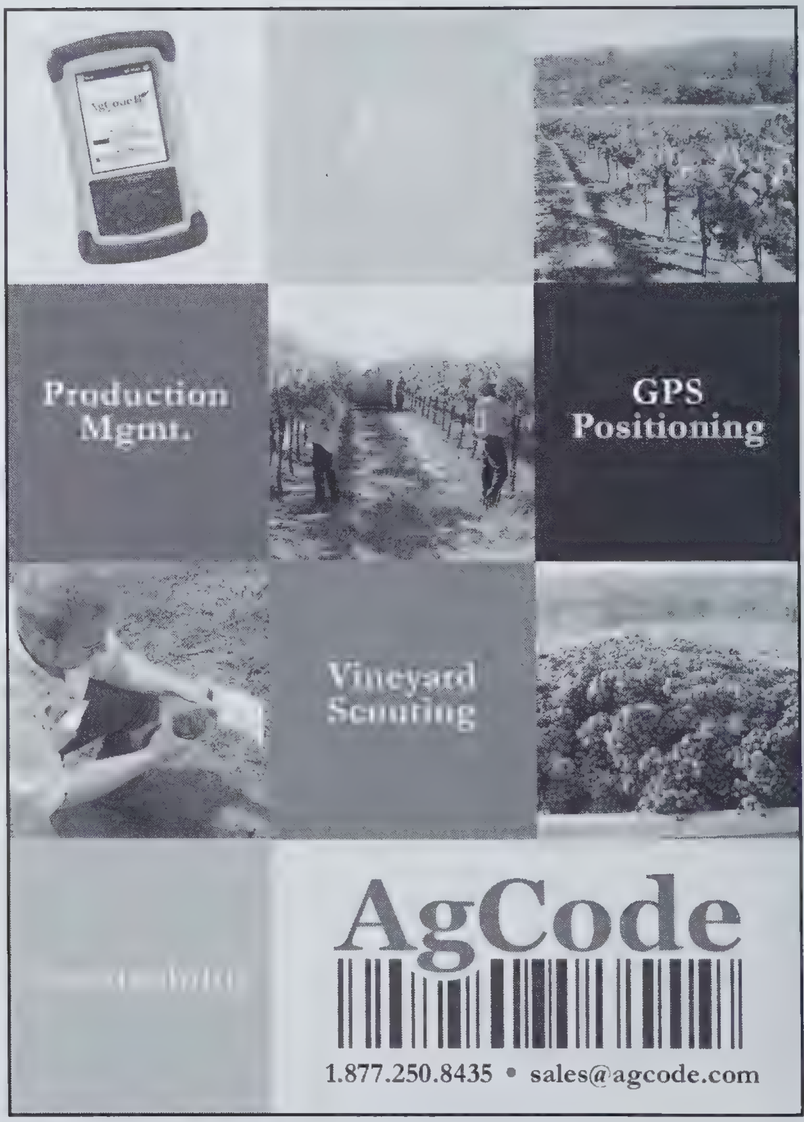

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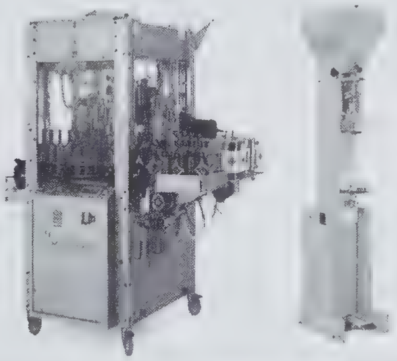

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PW WINERY & VINEYARD

March/April 2008

VINEYARD SHOWCASE

EQUIPMENT IRRIGATION SUPPLIES
SERVICES GRAPE BROKERS NURSERIES

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SUNRIDGE NURSERIES, INC.

Sunridge Nurseries, Inc., a full-service nursery, has been providing top-quality grape nursery stock to the wine and table grape industries for more than 30 years. Many different varieties and clones grafted on a choice of rootstock are available, and all material is hot water-dipped to ensure pest-free, high-quality vines.

Sunridge is an official ENTAV licensee. 2008 introductions include: Cabernet Franc 395, Colombard 551, Grenache Noir 287, Petit Manseng 573, Pinot Gris 457, Pinot Noir 386, and Sauvignon Blanc 906.

SUNRIDGE®
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Where the vintage begins

Horticultural experts are on staff and available to serve your vineyard.

Sunridge Nurseries offers an affordable plant protector to protect young vines from herbicide sprays, small animal feeding, and wind damage. When planting dormant vines, the top of the plant protector can be closed to simulate a greenhouse environment that enables vines to push buds without drying out. Once the roots take hold and the vine buds push, the plant protector can be opened or unsealed quickly (no shovel required) to simulate a common grow tube. Costly mounding expenses are avoided.

Contact Sunridge Nurseries today to satisfy all vineyard planting needs.

For more information, contact:
Sunridge Nurseries, Inc.
North Coast: Michael Monette
tel: 707/975-3646; vineguy@sonic.net
Central Coast: Andrew Jones
tel: 805/234-4920;
grapevinejones@gmail.com
Central Valley/outside California:
Mike Thomas
tel: 559/217-9778; vinemaker@aol.com
Table Grapes: David Mann
tel: 661/978-5696; dmann@sridge.net
441 Vineland Rd., Bakersfield, CA 93307
tel: 661/363-8463; fax: 661/366/4251
website: www.sunridgenurseries.com

PLEASE SEE SUNRIDGE NURSERIES AD, PAGE 15.

EURO-MACHINES, INC.

Euro-Machines introduced the BRAUD VL Grape Harvester in 2004. Now the Braud VX series harvester has all the improvements and innovations introduced through the VL series, and the VX is larger, has more horsepower, and a wide 32-inch throat.

State-of-the-art technology provides top-quality harvesting and full multi-function capability. The cab is sealed and pressurized for noise reduction and spray safety. A multi-function lever controls all harvester functions with pre-set picking programs and all multi-function attachments. Hydrostatic transmission with cruise control is standard.

The harvester head has a patented quick-shaker rod engagement; this enables activation of more or less shaker rods as the fruit zone requires. Varying leaf volumes of the vine, picking conditions, and grape varieties are easily handled by the operator viewing the picking process on a color monitor. Adjustments are just a fingertip away on the multi-function lever. Four highly efficient cleaning fans remove all leaves. For optimal cleaning efficiency, an optional patented destemmer makes it possible to destem and eliminate any MOG. The result is the cleanest fruit delivered to a winery by machine harvesting.

A large inventory of used, reconditioned, and lease-return machines is available.

For more information, contact:
Euro-Machines, Inc.
East: 540/825-5700
West: 4950 E. Fulton Dr, Cordelia, CA 94534
tel: 707/864-5800; fax: 707/864-5879
e-mail: info@euromachinesusa.com
website: www.euromachinesusa.com

PLEASE SEE EURO-MACHINES AD, PAGE 24.

JIM'S SUPPLY COMPANY, INC.

Jim's Supply Company is the nation's largest ***full service*** supplier, manufacturer, and distributor of vineyard and orchard trellising materials, serving the industry since 1959.

Jim's Supply has three fully-staffed locations to serve vineyard/orchard needs. Call Jim's Supply with vineyard/trellising requirements and the sales staff will answer questions directly, thoroughly, and promptly. Most staff have been in the vineyard industry for over 15 years. With this kind of experience, most of your questions will not come as a surprise to them.

Jim's Supply not only sells the material, but is able to design a system to meet your needs, and then fabricate the order inside its own manufacturing plant.

Jim's Supply prides itself in being the "go-to" supplier for hard-to-find items, and prides itself in looking toward the future, whether for seasonal items such as bird netting, tape, green film, hoop house supplies etc., or looking toward the future for products to save the customer time and money.

From the West Coast to the East Coast of North America (Mexico and Canada, too), Jim's Supply is a leading supplier for all of your needs.

Jim's
Supply Company, Inc.

For more information, contact:
Corporate Office/Manufacturing
3530 Buck Owens Blvd.
Bakersfield, CA 93308
toll-free: 800/423-8016; tel: 661/324-6514;
fax: 661/324-6566
Northern California/ Southern Oregon
4102-A St. Helena Hwy, Calistoga, CA 94515
tel: 707/945-JIMS (5467); fax: 707/942-9752
Central California / San Joaquin Valley
Mike Gostanian
cell: 559/930-6165
Central California / Coastal
Scott Spitzer
cell: 661/889-6000
office: 800/423-8016
Pacific Northwest / Washington Depot
8148 Stateline Road, Touchet, WA 99360
tel: 509/781-0898
e-mail: jimssci@jimssupply.com
website: www.jimssupply.com

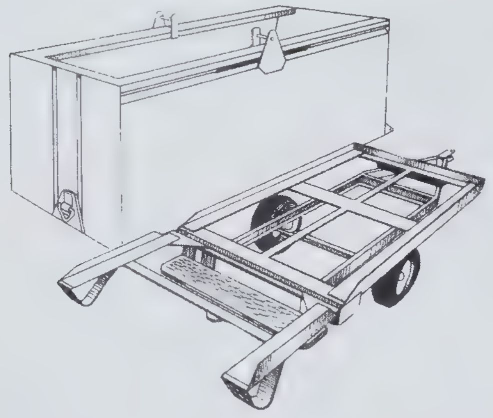
PLEASE SEE JIM'S SUPPLY COMPANY AD, PAGE 31.

WESTERN SQUARE INDUSTRIES

Since 1988, Western Square Industries has been a leading supplier of vineyard harvest equipment. Their products lead the industry in design, development, and dependability. Western Square manufactures vineyard bins and trailers in six styles for narrow or wide vineyard rows.

Western Square Narrow Row Trailers are designed specifically to allow conventional 4-foot wide harvest bins in narrow-spaced vineyards. The trailer carries Valley Bins or 1/2 ton or 1/4 ton plastic bins interchangeably. Western Square manufactures high-quality two-ton Valley Bins in mild steel or stainless steel.

New in 2008, Western Square introduces the 3-ton, self-dumping, Narrow Row Trailer Bin Dumper, with a welded steel frame, tandem axles, and rotating hitch. It is powder-coated and carries a removable stainless steel bin, which is bolted to the heavy-duty hydraulic lift system.



Trailer configurations accommodate two-ton harvest bins, or up to three 4x4 plastic bins. Several trailers have ramps and plastic slides to drop bins without needing a forklift. The tilt-trailer design eliminates the need for a hydraulic lifting mechanism. Simplicity of design and a durable powder coat finish contribute to easy maintenance. Add a 4x8 sheet of plywood and the trailer becomes a utility trailer for off-season projects.

Western Square is an industry standard.

For more information, contact:

Western Square Industries
Trygve Mikkelsen
1621 N. Broadway, Stockton, CA 95205
tel: 209/944-0921, toll-free: 800/367-8383
website: www.westernsquare.com

PLEASE SEE WESTERN SQUARE AD, PAGE 14.

TY-N-GRO™ PREMIUM TIE TAPE

Superior performance for plants ...

Ty-N-Gro™ is the grower's choice for premium tie tape. Ty-N-Gro's proprietary blend of stretch and strength ensures that planted stock is supported safely and securely.

Ty-N-Gro safely expands as plant grows, is secure, and offers rapid, easy application by hand or tying machine.

Premium Tie Tape

Ty·N·Gro™

Hassle-free use for growers —

By the roll, Ty-N-Gro's Color Core™ system means no more guessing the gauge of half-used rolls. Each tape gauge is also clearly printed inside every core.

By the HandiStak™ Ty-N-Gro's exclusive multi-roll wrapping ensures that every roll stays tightly rolled until you need it.

By the carton, Ty-N-Gro's color-coded cartons tell you, at a glance, what type of tape you have in stock. Bar codes provide quick and easy inventory. Three types to choose from: Hand Tie Tape (green box); Embossed Machine Tape (red box); or Budding and Grafting Tape (blue box).

Because growing challenges are many, Ty-N-Gro comes in a range of sizes and gauges designed to grow the bottom line with unbeatable performance and economical pricing.

For more information, contact:

Ty-N-Gro, c/o Plantra, Inc.
Steve Tillmann
tel: 800/518-6872; cell: 805/610-9663
fax: 805/462-1378
e-mail: steve@plantra.com
website: www.plantra.com

PLEASE SEE PLANTRA AD, PAGE 36.

SHUR FARMS FROST PROTECTION

Shur Farms' S.I.S. (Selective Inverted Sink) Frost Protection system is a proven, effective method of frost protection for frosty valleys, pockets, and swales. It is a cold air drain, pulling in the coldest air from the vineyard floor and sending it upward 300 feet, allowing warmer air to settle downward. This award-winning, patented system has been successfully used for over 14 years in ten countries.

The low profile S.I.S. consists of a vertical shaft with blades spinning parallel to the vineyard floor. It is powered by either tractor-PTO or 15hp gasoline power unit, making it low-maintenance and very cost-effective. It can be used independently, or with other frost protection methods, maximizing their benefit. Most S.I.S. systems have a 100% payback in the first year of operation.

The customizable S.I.S. comes in three sizes to protect from two acres on up. It is environmentally friendly, and quiet enough to use in residential areas. For convenience, the small and mid-size S.I.S. are delivered almost fully-assembled, require little site preparation, and may be removed from the field at the end of frost season.

For more information, contact:

Shur Farms Frost Protection
1890 North 8th St., Colton, CA, 92324
toll-free tel: 877/842-9688; fax: 909/825-2611
e-mail: shurfarms@earthlink.net
website: www.shurfarms.com

PLEASE SEE SHUR FARMS AD, PAGE 49.

CIATTI COMPANY

The Ciatti Company is the wine industry's oldest, largest, and most comprehensive grape and bulk wine brokerage in the U.S. and internationally.

Wine brokerage services include: grape contracts; grape processing contracts; complete negotiations of bulk wine purchasing and sales; tasting, blending, and finishing wines by on-staff enologists; objective information, including comprehensive long-term market analysis; evaluation of inventory quality and current market values; and locating unlabeled case goods or wine for private labeling.

The Ciatti Company has the most extensive and up-to-date product line of premium varietals; generic wines; grape and fruit concentrates; brandy and high proof from grape, citrus, and grain. Internationally, Ciatti brokers export U.S. wines to overseas markets and import foreign wines to California labels and wineries, including wines from Australia, Chile, France, Argentina, and other major wine growing regions, including South Africa.

John Ciatti, Greg Livengood, Steve Dorfman, Chris Welch, and John White specialize in premium coastal varieties and share responsibility for California wineries. Chris Braun and Dennis Schrapp cover international markets and wineries outside California. Glenn Proctor, Johnny Leonardo, and Todd Azevedo are responsible for brokering grapes, and assist with California wineries. Andy Bivona and Greg MaGill specialize in varietal juices and concentrates, beverage alcohol, and all natural grape colors.

For more information, contact:
Ciatti Company
1101 Fifth Ave., #170, San Rafael, CA 94901
tel: 415/458-5150; fax: 415/458-5160
e-mail: reception@ciatti.com
website: www.ciatti.com

PLEASE SEE CIATTI COMPANY ADS, PAGES 44, 45.

CALIFORNIA GRAPEVINE NURSERY, INC.

California Grapevine Nursery, certified by the California Department of Food & Agriculture, provides grapegrowers with high-quality planting materials. Available products include dormant rootstock and dormant grafted vines, at very competitive prices.

Choose from 21 varieties of certified rootstock including the French-developed Gravesac variety. A large selection of scion varieties and clones, including ENTAV-INRA® clones to customize your grafted-vine order, is also available. California Grapevine Nursery is a licensed agent of ENTAV-INRA® material in the U.S. with authentic clones from France.

CALIFORNIA GRAPEVINE NURSERY

California Grapevine Nursery employs state-of-the-art nursery practices to assure clean, healthy, and productive grapevines. An integrated pest-management program is utilized to carefully monitor vines and treatments are applied only when absolutely necessary. An integrated fertilization program provides vines with proper nutrition along with preplant soil conditioning. All vines are hot water-treated at no extra charge.

California Grapevine Nursery is dedicated to providing customers with the highest quality plants available and excellent, efficient customer service.

For more information, contact:
California Grapevine Nursery, Inc.
1334 Vidovich Ave., Ste. A
St. Helena, CA 94574
tel: 800/344-5688; fax: 707/963-1840
e-mail: sales@californiagrapevine.com
website: www.californiagrapevine.com

PLEASE SEE CALIFORNIA GRAPEVINE NURSERY AD, PAGE 17.

DOW AGROSCIENCES LLC

New vineyard plantings should provide decades of productivity. Considering the massive undertaking and expense of planting a new vineyard, soil fumigation is strongly advised where nematodes or "replant disease" are present.

Telone®

Everything grows better.™

Soil fumigation using Telone® soil fumigant creates a zone of protection around roots, allowing them to develop in an environment where nematodes are controlled and soil-borne diseases and viruses (such as grape fanleaf virus) are managed. The result: extensive, healthy root systems capable of producing decades of high-quality, high-yielding grapes.

The increased growth provided by Telone® (compared to untreated) is so dramatic that the cost of fumigation is often paid for with the first crop harvested. Plus, starting vines with a healthy, strong root system leads to many other benefits such as generating early growth response, promoting plant longevity, creating more efficient use of water and fertilizer and allowing for more rootstock choices.

To order the FREE guide, Managing Nematodes and Replant Disease in Orchards & Vineyards, call 888/395-PEST.

For more information, contact:
Dow AgroSciences LLC
9330 Zionsville Road, Indianapolis, IN 46268
tel: 888/395-PEST
e-mail: info@dowagro.com
website: www.dowagro.com

KORVAN MECHANIZATION EQUIPMENT

Oxbo offers a full line of Korvan mechanization equipment, designed as a comprehensive, integrated set of tool carriers and attachments to help growers produce higher quality grapes at low cost with less labor.

The Korvan system features three distinctive tool carriers: a tow-behind unit, a single row tractor-mounted unit, and a double-row tractor-mounted unit. This wide product range can be easily customized for any vineyard, regardless of size.

With precision rotary pruners, sprawl pruners, and sickle bar combination pruner/hedgers, there is a Korvan for any vineyard. The automated opening systems, ground speed matching and precision control, set the Korvan pruners apart from others on the market.

The Korvan vineyard mechanization system features an extensive line of attachments for canopy management: shoot thinners, vine trimmers, leaf removers, cordon brushes, and various mechanical yield management tools.

With a complete line of vineyard mechanization equipment aimed at providing cost- and labor-reducing solutions, the Korvan line now provides growers with many quality products needed for today's vineyards.

For more information, contact:
Korvan Equipment by
Oxbo International Corp.
2550 Bethel Ave, Kingsburg, CA 93631
tel: 559/897-7012
Greg Berg: 559/859-7268
e-mail: vineyard@oxbocorp.com
website: www.oxbocorp.com

PLEASE SEE OXBO AD, PAGE 28.

PREMIEREVISION SOFTWARE

Are you meeting your wine quality goals? Take your vineyard to the next level with PremiereVision vineyard database. PremiereVision was designed by viticulturists and vineyard managers to track and report data, facilitate communication, save time, and improve quality.

PremiereVision is a secure, web-based application — there is no software to install, and no hardware to buy. Access your data from the office, from home, or from the field. Winemakers or farming clients can create their own reports with "view only" passwords.

premiere

All standard data is tracked. Time-saving tools include:

- Crop estimation module;
- Work orders for sprays, fertilizers, cover crops, irrigation, and cultural practices;
- Summary reports;
- Auto-calculation for ordering materials;
- Budgeting templates;
- Use iPhone or Treo to access in the field.

PremiereVision was designed from the ground up by people doing your job. It is used every day to farm high-quality wine grapes.

Call Premiere Viticultural Services for a demo.

For more information or a demo, contact:
Premiere Viticultural Services, Inc.
855 Bordeaux Way, Ste. 100, Napa, CA 94558
tel: 707/261-8750; cell: 707/486-2429
website: www.premierevit.com

PLEASE SEE PREMIERE VITICULTURAL SERVICES AD, PAGE 36.

AGCODE, INC.

AgCode has designed an information management solution to meet the unique needs of the vineyard industry. AgCode's Total Ranch Solution is a complete field-data collection system featuring a premier field payroll solution, including payroll data collection and pay rule processing.

Total Ranch includes production planning and budgeting, resource data collection (including equipment and chemical), viticulture scouting, and phenology tracking.

AgCode
MOBILE.NET

AgCode's full reporting suite allows users to go from "dock to doc" by docking the handheld to synchronize data to the web and create business-intelligence documents tailored to their needs.

Payroll and production data collection is more efficient and precise by combining Windows Mobile technology, bar code scanning, GPS technology, secure web-based data systems, and AgCode's Command Code technology.

AgCode's premier payroll solution allows supervisors to record time and productivity of a field labor force and collect information on the worker, crop harvested, or application performed while in the field. Payroll data is collected in the field using Windows Mobile handheld technology by using a Palm® Treo™ or TDS Nomad™. The data is then synchronized to a secure website where pay rules are calculated. Employee hours can be viewed, audited, and approved for export into any back-office software.

For more information, contact:
AgCode, Inc.
608 W. Fifth St., Starbuck, MN 56381
tel: 877/250-8435; fax: 320/239-7312

PLEASE SEE AGCODE AD, PAGE 64.

A&J VINEYARD SUPPLY, INC.

With the New Year unfolding, the team at A&J Vineyard Supply is already in full swing, working with growers and managers to insure that their pruning and tying supply needs are met, and that their spring planting project requirements are being addressed.

With its internal operations now strongly established, the sales team at A&J will be visiting vineyards in 2008. Look forward to seeing sales associates Cliff Little and Rey Sanchez on the road and in the fields to offer product advice, answer questions, and keep you updated on developments in trellising.

A&J Vineyard Supply

"Quality, timing, and exceptional customer service is our focus and greater mobility of our sales team will insure that we continue to excel in those areas."

The home office and yard continues to be fully staffed and stocked with line posts, t-posts, end posts, cross-arms, earth anchors, wire, training stakes, fencing, irrigation, grow tubes, and all the other tools and accessories vineyard managers are accustomed to finding at A&J Vineyard Supply.

"Everybody at A&J loves this industry and looks forward, every day, to being a part of it," say owners Augusto and Jennifer Di Battista.

For more information, contact:
A&J Vineyard Supply, Inc.
Cliff Little: 707/477-9002
Rey Sanchez: 707/591-4022
900 N. Crane Ave., St. Helena, CA 94574
tel: 707/963-5354; fax: 707/967-8542
website: www.aj-vineyardsupply.com

PLEASE SEE A&J VINEYARD AD, PAGE 60.

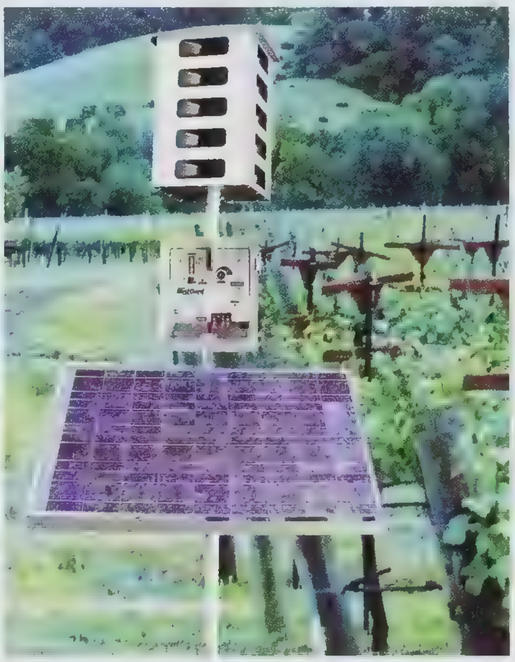
BIRD GARD / JWB MARKETING LLC

The Mega PRO 200-watt amplifier has 120 decibels of output and covers 30 acres. It's 60 times more powerful than the Bird Gard Super PRO II that covers up to six acres. Included with the mega PRO is a 20-speaker tower, and a 40-watt solar panel. List: $3,000; Discount: $2,400.

What vineyard managers say about the Mega PRO:

"Had the starling flocks been there, we would have lost $20,000 to $30,000 worth of grapes." Jack Keller, Hazlitt 1852 Vineyards, New York.

"All the birds just left ... no birds returned. We even stopped using the cannons. The Mega PRO really did a great job." Bob Kidston, Dykeview Farms, Nova Scotia.



"The Mega PRO paid for itself the first season because of the money we saved on bird patrols and pyrotechnics." Daryl Salm, Valley Farm Management, California.

For more information, contact:
Bird Gard/JWB Marketing LLC
Jim Burton
2308 Raven Trail, West Columbia, SC 29169
tel: 800/555-9634; fax: 803/796-0654
website: www.birddamage.com

OXBO INTERNATIONAL CORP.

Oxbo offers a full line of Korvan vineyard products, including grape harvesters, sprayers, and multi-function.

For 2008, Oxbo is adding the Korvan 3-row sprayer as a module for the Korvan-4012 multi-function harvester. The sprayer features 12 Cropland™ spray heads, 750-gallon stainless steel tank, and hydraulically-adjustable row width and height.

Also new for the Korvan-4012 are dual rear 3-point hitches for performing various vineyard tasks. The 3-point hitches feature 60 PTO hp per side and remote attachment ports for hydraulic-driven equipment.

The full-production Korvan-4012 features a 275hp engine positioned between the tires for a low center of gravity, 30-inches of side-to-side leveling, and an electronically-controlled, all-wheel ground-drive system for unmatched performance in hillside conditions. The 4012 can be easily mounted with a front tool bar, making it a versatile power unit for year-round operation.

Korvan also offers tow-behind, self-propelled, and wide trellis grape harvesters. You can trust each American-made Korvan grape harvester to deliver high-quality fruit. Each Korvan utilizes a soft-touch bow rod harvesting system and bucket conveyance that gently carries grapes to the bin or gondola, giving clean, whole fruit.

For more information, contact:
Oxbo International Corp.
270 Birch Bay Lynden Rd., Lynden, WA 98264
toll free: 888/6-KORVAN
Mitch 559/285-5804; or **Jon** 360/815-1551
e-mail: vineyard@oxbocorp.com
website: www.oxbocorp.com

PLEASE SEE OXBO AD, PAGE 28.

Spec Trellising

Spec Trellising, a family-owned and operated trellis supply company, works closely with customers and meets their needs with high-quality trellis materials and trellis-related products at reasonable cost, with first-rate service.

Spec recommends only top-quality, long-lasting trellising materials for grapevine trellising. While lower-quality products can undoubtedly be found, it is Spec's sincere belief that trellis construction is a laborious, costly task that should be done right the first time, using only the finest products. Research indicates that good, sound canopy management is critical to formation of high-quality fruit, and begins with proper materials.

Spec's diversified product line includes everything grapegrowers need to trellis and train vines, and to manage canopies. The company's products are among the best of their kind in the world, and include steel posts, hi-tensile wire, vine shelters, bird netting, vine-tying products, and more.

The new Prothec System is a patented combination of Prothec pliers and degradable Prothec ties. The unique design of the Prothec tie combines large width with expandable embossed finish, which prevents girdling and other vine damage. The Prothec system allows growers to quickly secure vines to trellis wires by twisting and cutting the expandable tying material in one quick action. Spec offers four different grades of Prothec tying material.

For more information, contact:
Spec Trellising
39 Indian Dr., Ivyland, PA 18974
tel: 800/237-4594, or 215/322-5588
fax: 215/357-3122
e-mail: info@spectrellising.com
website: www.spectrellising.com

PLEASE SEE SPEC TRELLISING AD, PAGE 52.

Grover Soil Solutions

Grover Soil Solutions is committed to providing sustainable solutions for soil through the use of premium compost and custom blends. WonderGrow compost is a well-decomposed, weed-free organic soil amendment. It is derived from yard trimmings, source-separated plant material, and agricultural and food residuals. WonderGrow contains **no** biosolids, animal waste, or substances toxic to plants. It is free of man-made foreign matter (<1% by dry weight).

Strong, healthy, and productive plants thrive in soils that have an abundance of macro and micronutrients. A healthy soil ecology is sustained by high levels of soil organic matter. Natural decomposition processes constantly cycle nutrients for plant growth, feed soil microbiology, and stabilize the soil's physical environment.

Grover Soil Solutions has a team of ag consultants, PCAs, and CCAs who work to identify soil factors limiting plant productivity. Through soil testing, tissue analysis, and field observation, Grover develops recommendations and customizes compost blends to fit each unique growing environment.

Grover has several spreader configurations available as rentals to meet vineyard needs.

For more information, contact:
Grover Soil Solutions
6224 Stoddard Rd., Modesto, CA 95356
tel: 866/764-5765; fax: 209/545-3315
website: www.wondergrow.biz

PLEASE SEE GROVER SOIL SOLUTIONS AD, PAGE 65.

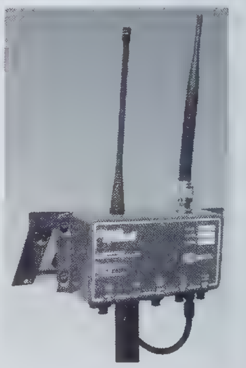
Ranch Systems LLC

Ranch Systems provides real-time, online micro-climate weather stations, soil monitoring, and remote irrigation control for single or multi-ranch applications.

Ranch Systems' wireless mesh networking telemetry equipment and online software interacts with a variety of sensors to gather/transmit vineyard information to a secure website. Customers can view charts, set custom alerts and triggers, generate reports, and activate valves and equipment online, or download information to a spreadsheet for their own calculations.

Ranch Systems' solutions work with a range of sensors including soil moisture, temperature, relative humidity, wind speed and direction, and rainfall, to provide calculated measures such as Powdery Mildew Index, and Evapotranspiration (ETO).

Systems are modular, requiring zero programming for flexible and cost-effective coverage of multiple blocks or properties.



NEW in 2008 is the RanchMaster 200-series wireless node, a modular vineyard control system that provides weather station, microclimate, soil moisture monitoring, and wireless irrigation control functions at prices starting around $2,000. This system provides integrated support for a wide variety of probes, including AgriLink's new fourth generation C-Probe™ the AquaSpy™ that delivers the most advanced multi-level soil moisture monitoring technology, providing comprehensive information to match irrigation requirements for improved yield and quality. Ranch Systems is the preferred reseller for Agrilink soil moisture probes in Northern California.

For more information, contact:
Ranch Systems LLC
885 Olive Avenue, Suite A, Novato, CA 94945
tel: 415/898-5900
website: www.ranchsystems.com

BARE-HAND™ BIRD NETS

Bare-Hand™ bird nets are the complete answer to assuring the flavor of your fruit crop in the battle against bird damage. Today's premium grower manages for flavor and appearance; the essence of the harvest. To this end, your investment demands a return based upon flavor quality.

Netting is the most effective means of protecting fruit flavor prior to harvest, and Bare Hand™ has the solution to fit your application, and help assure the true flavor essence of the vineyard makes it to the crush pad. From single and multi-row coverage in vineyards, to overhead structures for orchards, Bare-Hand has a solution to protect the crop.

Think bird netting is too expensive? Bare-Hand actually reduces the cost of producing high-quality wine. Only bird netting provides complete, continuous 24/7 protection against both crop loss and bird peck damage, and Bare-Hand has the range of solutions necessary to cover any application.

If you are a premium fruit producer, Bare-Hand has you covered. To learn more about how to FlavorGard™ your vineyard with Bare-Hand™ Bird Nets, call today.

For more information, contact:
Bare Hand Bird Nets, c/o Plantra, Inc.
Steve Tillmann
tel: 800/518-6872; cell: 805/610-9663
fax: 805/462-1378
e-mail: steve@plantra.com
website: www.plantra.com

PLEASE SEE PLANTRA AD, PAGE 36.

WEED BADGER DIVISION

Effective, safe, and economical in-row weed control.

Weed Badger Division manufactures in-row tillers, mowers, and attachments to eliminate the worst weed nightmare without using any herbicide or hand labor. Since 1979, Weed Badger® has offered solutions to in-row problems. Kill all the weeds, hill up, hill down, mow, sweep, rake, cleanup, aerate, incorporate amendments — all with just one machine.

One Weed Badger® replaces the work of 200 hand laborers. Destroy herbicide-resistant weeds. No more hassles, liability, or risk with dangerous chemicals. A one-time investment gives a lifetime of dependable weed control. Weed Badger® offers upgradeable models to fit every budget and grow with the vineyard.

The Model 4200 Weed Badger® series is designed for smaller, lighter, more fuel-efficient, 18 to 30 HP tractors. This rugged model adds as little as 9 inches to the tractor width when retracted. The Model 4020 fits tractors 25 to 90 HP and is equipped with an active cooler to keep working long, hot days, every day. All models feature interchangeable tools and attachments.

Take advantage of excellent factory-direct service and prices. Ask for the free VHS or DVD.

For more information, contact:
Weed Badger Division
of Town & Country Research and Development, Inc.
5673 95TH Ave SE, Marion, ND 58466
tel: 701/ 778-7511; toll-free: 800/437-3392
fax: 701/ 778-7501
e-mail: inquiry@weedbadger.com
website: www.weedbadger.com

PLEASE SEE WEED BADGER AD, PAGE 22.

VINTAGE NURSERIES

Vintage Nurseries is one of North America's largest producers of dormant field-grown benchgrafts. Vintage Nurseries' advanced facility allows the greatest quality control in the industry today. Customers quickly discover that one call is all they need to receive the best value, with highest quality grapevines at the most competitive price-point in the industry. Vintage Nurseries includes hot-water-dipping, designed to eliminate vine mealybugs and other pests and pathogens, at no extra cost.

Vintage Nurseries also produces greenhouse-grown benchgrafts, rootstock rootings, own-rooted vines, and cuttings. Located in California's southern San Joaquin Valley, Vintage Nurseries propagates all plants in one of North America's best climates for a grapevine nursery.

Vintage Nurseries currently has a wide selection of popular varieties including Syrah, Pinot Noir, Cabernet, Merlot, Sauvignon Blanc, Chardonnay, and many more. Vintage Nurseries also offers the new table grape releases: Scarlet Royal, Autumn King, and Sweet Scarlet, along with its selection of other table and raisin grape varieties.

All customers and industry professionals are welcome to visit the facility and growing grounds.

For more information, contact:
Vintage Nurseries
Nicholas Podsakoff, No. Central Vly CA, Texas, Canada:
tel: 209/456-0697
Dave Haggmark, Central coast CA, Eastern U.S.:
tel: 805/391-0905
Mike Enns, South Valley wine grapes, table grapes:
tel: 661/747-1582
Ken Noren, North coast CA, OR, WA
tel: 707/975-3416
Dustin Hooper, Office sales and inquiries
tel: 661/758-4777 x 421

PLEASE SEE VINTAGE NURSERIES AD, PAGE 25.

DUARTE NURSERY, INC.

Choose Duarte Nursery Big Pot Benchgrafts for your vineyard; measure the quality by their performance. Duarte offers Big Pot Benchgrafts with a guaranteed stand and free delivery in most of California and Oregon.

Duarte offers one of California's best vineyard service teams. A Duarte viticultural consultant is available to provide sales and service throughout California and Oregon grapegrowing regions.

With the use of Big Pot Benchgrafts and consultation from Duarte's vineyard service team, you are guaranteed a successful planting.

Duarte defines quality as your complete satisfaction. Please call today.

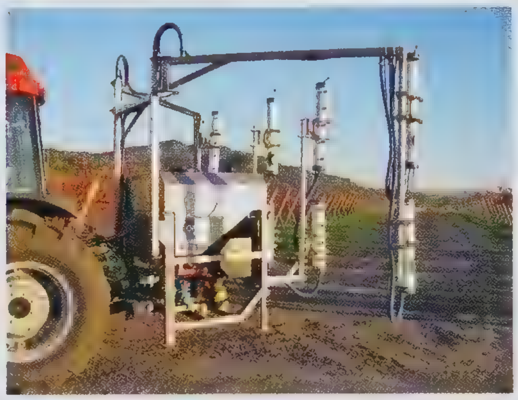
For more information, contact:
Duarte Nursery, Inc.
1555 Baldwin Rd., Hughson, CA 95326
tel: 209/531-0351; fax: 209/531-0352
e-mail: sales@duartenursery.com
website: www.duartenursery.com

PLEASE SEE DUARTE NURSERY AD, PAGE 26.

PROGRESSIVE GROWER TECHNOLOGIES, INC.

On-Target offers a line of electrically-charged sprayers for growers in the vineyard, orchard, row-crop, and nursery industries. For over a decade, Progressive Grower Technologies (PGT) has improved the sprayers and expanded to include the western U.S., Australia, and South America.

On-Target sprayers produce billions of electrically-charged spray drops per minute. All charged-drops are attracted to a plant, resulting in unequaled coverage and uniformity and radically reducing drift and runoff, which are the most wasteful and costly processes in any spray program.



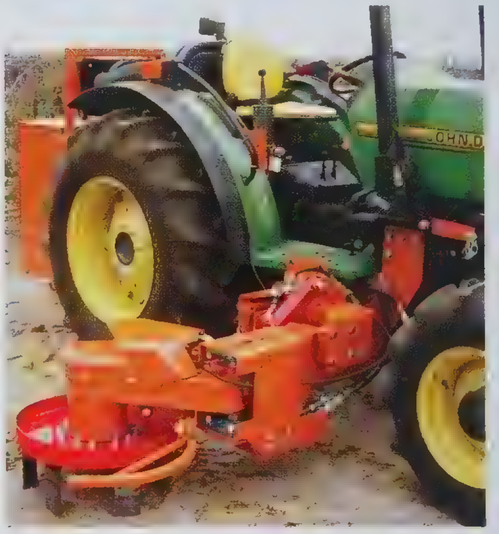
On-Target sprayers are designed and fabricated in California. The stainless steel construction is compact and of the highest quality. With this design comes flexibility; unlimited adjustment capabilities for single- or double-row, running parallel with any trellis system for uniform coverage. Growers have experienced reduced application time, pesticide quantity, and risk to employees — a great advantage over traditional spraying methods.

The On-Target system has proved itself to be efficient and reliable, spraying more acres in one day than any other sprayer.

For more information, contact:
Progressive Grower Techologies, Inc.
31421 SW Olympic Dr., Wilsonville, OR 97070
tel: 503/549-0607; fax: 503/682-9496
e-mail: hartman6@comcast.net
website: www.ontargetspray.com

KIMCO MANUFACTURING, INC.

If you are looking for a way to reduce the cost of controlling in-row weeds, Kimco Manufacturing has an answer. The Kimco Model 9300 is a heavy-duty in-row tiller that operates in virtually any vineyard. It can remove weeds — including just-sprouted and those that have grown clear into the vine canopy. The Kimco 9300 works well under extreme conditions, and is gentle on young vines.



Designed specifically to work under drip lines, the Kimco 9300 works in soil conditions that other machines cannot, from sand to clay to rocks in virtually any combination. It does all this often more effectively and at a lower cost per acre than chemical weed control.

The Kimco is always mounted ahead of the operator for best visibility and operator convenience. The operator has fingertip control of all machine functions. The automatic vine sensor can be easily overridden by the operator, and the tilling depth can be adjusted on-the-go.

With many years of proven durability, the Kimco Model 9300 in-row tiller and its companion, the Kimco M-9700 in-row mower, have proven to be very cost-effective devices to mechanically control in-row weeds.

For more information, contact:
Kimco Mfg., Inc.
9200 W. Barstow Ave., Fresno, CA 93723
tel: 559/277-9300 or 800/356-9641
fax: 559/277-9358
e-mail: sales@kimcomfg.com
website: www.kimcomfg.com

PLEASE SEE KIMCO MFG. AD, PAGE 57.

CENTRAL VALLEY BUILDERS SUPPLY

CVBS opened its doors in 1955 to supply building materials to surrounding builders. Since then, CVBS has grown into one of the largest suppliers of vineyard products and equipment in the industry.

The CVBS Agricultural Division is a complete supplier that carries a large assortment of trellising, fencing, irrigation, drainage, erosion control, pruning, spray, Macrobins, harvest supplies, and much more. Please visit the website, www.cvbsupply.com, for a complete list of suppliers and links, or call one of the three locations.

CENTRAL
VALLEY
BUILDERS SUPPLY
AGRICULTURAL DIVISION

CVBS opened its fifth overall location (third store focused on ag products) in Healdsburg, CA in 2006. Healdsburg is a 10,000 sq ft. store with a 1.5-acre materials yard, completely designed around everything an agricultural customer would need.

As CVBS expands into new territories, the commitment continues to be the same: A total vineyard supplier that is responsive, flexible, and creative in solving customer needs. With a distribution facility and a fleet of delivery trucks, CVBS Ag Division has the materials that customers need, with the ability to deliver the product where customers need it most, on the job, and on time.

For more information contact:
Central Valley Builders Supply
1100 Vintage Ave., St. Helena, CA, 94574
tel: 707/967-4300; fax: 707/963-8952
1790 Soscol Ave., Napa, CA, 94559
tel: 707/257-8888; fax: 707/261-2962
160 Grant Ave., Healdsburg, CA, 95448
tel: 707/473-9722; fax: 707/473-9688

PLEASE SEE CENTRAL VALLEY BUILDERS AD, PAGE 32.

YANMAR AGRICULTURAL MACHINERY

The new Closed Cab Edition (CCE) of the Yanmar-T80 tractor is an all-weather machine powered by Yanmar's TNV direct-injection diesel engine. Its compact, Tier-III compliant powerhouse features advanced electronic fuel injection, and an exhaust-gas recirculation system for maximum job impact with a delicate environmental footprint. A 38-gallon tank provides enough fuel for a productive day's work.

The T80-CCE transmission has 12 forward and reverse gears providing the perfect engine speed for every application, plus a 10mph paved surface capability.

The T80-CCE offers two track widths (65-inch and 53-inch), and internally-reinforced rubber tracks in conjunction with a compaction factor of only 3.2psi for the standard model. FDS (Forced Differential Steering) technology gives operators precision control rivaling traditional wheeled tractors. Improved steering allows the driver to concentrate more on the attachment function rather than tractor control.

The T80-CCE features heating, air-conditioning, deluxe fabric seat, armrest, tilt steering wheel, and elbow and leg room to spare. Fore and aft halogen lighting keeps production on schedule even after the sun goes down.

Yanmar Agricultural Machinery is a division of Yanmar America, a leader in small diesel engine design since 1912. This diversified, global company specializes in industrial, construction, agriculture and marine markets.

For more information, contact:
Yanmar Agricultural Machinery
101 International Parkway
Adairsville, GA 30103
tel: 770/877-6224
e-mail: kyasuda@yanmar-ga.com
website: www.yanmar.com

BUENA TIERRA VINEYARDS INC. MANAGEMENT & CONSULTING

All aspects of vineyard management including; consulting, recommending, and making available organic, biodynamic, and sustainable farming techniques, workers, and equipment to enable vineyard growers to maximize the quality, longevity, and yield of the vineyard are available.

As a management corporation, the specific services offered include:

- Providing expert workers who perform complete daily farming operations including pest and weed control;
- Pruning, leafing, hedging, and harvesting;
- Both full-time and contract labor to fill your needs;
- Consulting regarding pest control, vineyard layout, rootstock, virus protection, and fertilizers;
- Scouting for disease detection, monitoring of insects, and weed control;
- Collecting vineyard samples of tissue/petioles, water, soil, ELISA, nematode, and soil fungus;
- Providing pressure chamber analysis to determine vine water content and irrigation timing;
- Providing complete vineyard removal and installation;
- Offering field worker safety certification.

For more information, contact:
Buena Tierra Vineyards Inc.
Jeff Hill, Partner
Steve Kline, Partner
PO Box 3928, Yountville, CA 94599
tel: 707/944-2611; fax: 707/944-2611
e-mail: info@buenatierravineyards.com
website: www.buenatierravineyards.com

PLEASE SEE BUENA TIERRA VINEYARDS AD, PAGE 18.

JMS FLOWER FARMS, INC.

JMS Flower Farms offers JMS Stylet-Oil and Organic JMS Stylet-Oil to winegrape growers. The food-grade white oil formulations are valuable tools for growers interested in economical, effective pest control in the vineyard.

Organic JMS Stylet-Oil is approved for organic use, and is OMRI-certified. Both products, referred to as "Stylet-Oil," control powdery mildew and botrytis. Working as an eradicant and preventative, Stylet-Oil kills powdery mildew on contact, and maintains control in a 10-to 14-day spray interval.

University-tested on grapes for 15 years, Stylet-Oil is recognized by leading researchers, including Dr. Doug Gubler of UC Davis, and Dr. Wayne Wilcox of Cornell University (NY) as one of the best eradicants on powdery mildew, and one of the few "soft" materials to control powdery mildew. Stylet-Oil can replace sulfur sprays for powdery mildew control. A four-hour re-entry interval, and 0 days pre-harvest interval, allows workers safely and quickly back into the vineyard, with no sulfur irritation.

Stylet-Oil controls plant-feeding mites, mealybug, scale, and leafhoppers. Stylet-Oil is tank-mixable with most fungicide, insecticide, or foliar sprays (10-day interval with sulfur and 14 or more with Captan), allowing flexibility in integrating this material into your spray program.

While effective on a broad range of pests, Stylet-Oil is not harmful to populations of beneficial insects.

Economical and biodegradable, Stylet-Oil is a plus for grape growers seeking safe, effective pest control programs.

For more information, contact:
JMS Flower Farms, Inc.
4423 5th Place SW, Vero Beach, FL 32968
tel: 772/562-8770; fax: 772/562-7202
e-mail: styletoil@aol.com
website: www.stylet-oil.com

PLEASE SEE JMS STYLET-OIL AD, PAGE 29.

SPECTRUM TECHNOLOGIES, INC.

Spectrum Technologies has been a leader in weather-monitoring, irrigation, nutrient-management, and IPM technology since 1987. Years of hands-on farming and agricultural experience, coupled with technical know-how, makes Spectrum a great resource to help grow consistent, high-quality grapes at low cost.

Spectrum
Technologies, Inc.

WatchDog Frost Alert — Spot frost from miles away. A high-powered LED light changes color and flash frequency to indicate when temperatures approach freezing.

WatchDog Weather Stations/Dataloggers — Adjust irrigation, nutrient, and pest-management methods to fit actual conditions and growing trends in the vineyard with easy-to-use, battery-powered weather monitoring systems. Fifteen station and logger choices and countless sensor arrays allow users to choose the system that best fits their needs and budget.

WatchDog Sprayer Station — All-in-one weather station measures air temperature, humidity, dew point, wind chill, barometric pressure, and apparent wind speed and direction. Reliability is enhanced by eliminating moving parts: the traditional wind vane and cups have been replaced with ultrasonic transducers.

WeatherTracker degree-day recorders — Record user-specified degree-days, chill hours, daily and monthly temperature data. Models to record specific conditions (soil moisture, rainfall, etc.) and forecast powdery mildew are available.

Grape Alert disease models — University-validated models to forecast powdery mildew, black rot, and insect emergence are available for most WatchDog systems. Avoid costly sprays with powerful grape disease data.

For more information, contact:
Spectrum Technologies, Inc.
12360 S. Industrial Dr. East
Plainfield, IL 60585
tel: 800/248-8873, or 815/436-4440
fax: 815/436-4460
e-mail: info@specmeters.com
website: www.specmeters.com

PLEASE SEE SPECTRUM TECHNOLOGIES AD, PAGE 49.

AGAJANIAN VINEYARDS

Agajanian Vineyards, wine grape merchant and bulk wine negociant, provides a variety of services to satisfy its customers' various needs.

Winery Services: Wine Grape Procurement: Agajanian Vineyards assists in finding exceptional values on wine grapes throughout California on a brokerage or full-service basis, and helps assure customers the grapes to fulfill market demand.

Grower Services: Grapes for Sale Listing: Available wine grapes are listed and, once contacted by winery clients, the Agajanian Vineyards' data base will be accessed for a match (no charge).

Grape Marketing: To find the best possible market for wine grapes, list the grapes as above, and Agajanian Vineyards will actively market the grapes by:

- Presenting grapes in a professional manner to wineries throughout North America;
- Promoting the grapes through advertising, fax, and email campaigns, direct mail, telephone, and personal meetings;
- Saving customer-time finding qualified buyers,
- Giving customers market feedback;
- Assisting customers with long-term planning.

For more information, please contact:
Agajanian Vineyards
North Coast: Chris Lindelof
tel: 707/894-1828; cell: 707/696-7164
and Chris Rogers
cell: 707/756-2090
California: Gary Agajanian
10174 Highway 41, Madera, CA 93636
cell: 707/480-0474
Central Coast: John Tufunkjian
cell: 805/975-7001
e-mail: gary@agajanian.com
website: www.agajanian.com

KENDALL-JACKSON NURSERY

Kendall-Jackson Wine Estates raised the bar of nursery quality in 1993 when it opened an in-house nursery to customers throughout the industry. "The Madera, CA nursery has become one of the nation's largest grapevine resources since it opened in 1993," says Ernie Bowman, nursery general manager.

"We do things our own way from start to finish because we are so focused on, maybe even a little obsessed with, quality," he adds. "Our quality is second to none in the industry."

The nursery has prized scionwood cuttings from some of California's choicest vineyards, including those on Mt. Veeder in Napa County, and Alexander Mountain Estate in Sonoma County.

One key to quality at the nursery is a trellised rootstalk block. Trellising, the exception rather than the rule at most nurseries, gets the rootstalk off the ground for ideal sun exposure, reduces pest and fungus pressures, and encourages straight cuttings for grafting.

Vines are custom-cultivated to meet various requirements in terms of disease resistance, vigor, and drought tolerance. Dormant benchgrafts, dormant rootings, green benchgrafts, and green quick-starts are available. The nursery accepts custom orders and offers free delivery for orders of more than 10,000 vines.

Additional information about the nursery and its products is available at the Kendall-Jackson website: www.kj.com.

For more information, contact:
Kendall-Jackson Nursery
Ernie Bowman, General Manager
1190 Kittyhawk Blvd., Santa Rosa, CA 95403
tel: 707/836-2021; fax: 707/836-2266
website: www.kj.com

PLEASE SEE KENDALL-JACKSON NURSERY AD, PAGE 47.

RAY CARLSON & ASSOCIATES, INC.

Did you know that you could increase the profitability of your vineyard using GIS?

GIS — How can you manage it if you have not measured it? A Geographic Information System (GIS) ties maps to a database.

Ray Carlson & Associates have vineyard consultants, PCA, and a GIS team on staff to help you:

- **Organize** your data — and obtain vital knowledge from key personnel;
- **Prepare** for regulations — governmental or environmental;
- **Improve** management, your product, and your team using GPS to locate critical utilities.

... Plus much more!

Mapping — Appellation Custom color Appellation maps, showing your winery or vineyards, are a unique marketing tool. Ray Carlson & Associates has aerial photo and mapping resources ready to create a distinct map.

Surveying — Did you know that a current survey might help you increase your property value?

Ask how!

GPS — Ray Carlson & Associates uses the latest technology, but believes that high-tech will never replace high-touch.

Ray Carlson & Associates combines a variety of high-quality products with dedication to customers and their needs, and have been surveying and mapping land in Sonoma county and surrounding California counties since 1976.

For more information, contact:
Ray Carlson & Associates, Inc.
411 Russell Ave., Santa Rosa, CA 95403
tel: 707/528-7649; fax: 707/571-5541
e-mail: rca@rcmaps.com
website: www.rcmaps.com

PLEASE SEE RAY CARLSON & ASSOCIATES AD, PAGE 52.

THE WINEGROWING CONSORTIUM

Dr. Paul Anamosa: Vineyard Soil Technologies
Nathan Baty: Viticultural Services
Greg Bjornstad: Bjornstad Consulting
Mike Bobbitt: Mike Bobbitt & Associates
Tucker Catlin: Estate Vineyard Design & Development
Dr. Mark Greenspan: Advanced Viticulture
Dr. Daniel Roberts: Integrated Winegrowing
Dr. James Stamp: Stamp Professional Viticulture Services

After years of collaborating on vineyard design, wine quality improvements, and technical troubleshooting, these independent viticulturists have joined to provide an integrated service. Consortium members are committed to working closely with owners, winemakers, and vineyard managers to improve wine quality while achieving financial efficiency.

Clients — Consortium clients are often wineries with estate vineyards looking to improve wine quality or refocus vineyard activities and grower relations to better support winemaking/marketing goals. Quality, quantity, and costs are all considerations, with most clients in the ultra-premium and luxury categories.

New vineyards — The critical design process begins with a **site assessment** of soils, climate, topography, and wine goals. The final plan integrates blocks with soils and slopes, while selecting the best variety/clone and rootstock, spacing/row direction, and trellis/irrigation combinations for a site. To preserve this design, **ongoing supervision** guides the process through permitting, engineering, budgeting and into planting, training, and production.

Producing vineyards — Long-term winegrowing strategies are also applied to producing vineyards. The effects of pruning, canopy, irrigation, yield, uniformity, and ripening are all integrated to achieve winegrowing goals. For contracted fruit, extensive grower relations experience can evaluate fruit sources and match contracts or leases to winery needs. Design, supervision, and interpretation are available for viticultural experiments and weather data, where GIS maps and data management are incorporated into most projects.

For more information, contact:
The Winegrowing Consortium
tel: 888/897-3030
e-mail: info@winegrowingconsortium.com
website: www.winegrowingconsortium.com

PLEASE SEE THE WINEGROWING CONSORTIUM AD, PAGE 55.

SUREHARVEST, INC.

As competitive pressures across the wine industry intensify, vineyards must optimize fruit quality and yield while controlling costs. The value of timely, site-specific, and easily accessible vineyard information to enhance management decisions continues to increase. The ability to document and communicate sustainable winegrowing practices is an emerging competitive advantage.

SureHarvest empowers customers with information they need to optimize quality and yield, benchmark best practices, and increase efficiency. SureHarvest offers an integrated vineyard information management software package with professional and responsive IT services.

Implement the fully-integrated viticulture enterprise system or individual modules including canopy management; chemical and fertilizer applications; contracts; harvest; irrigation; mapping; weather; and sampling/scouting.

SureHarvest
SUSTAINABILITY SOLUTIONS

Use SureHarvest's robust report writer to produce cross-farming category reports, offline/mobile capability to access the system anywhere at any time, user-defined fields, activity templates and reports to reflect the unique aspects of your vineyard.

By working in partnership with CAWG, Wine Institute, CSWA, and regional associations on the Sustainable Winegrowing Practices program, SureHarvest is uniquely positioned to offer products and services that integrate best practices with viticulture software. SureHarvest software solutions are used on more than 62,000 acres of California premium winegrapes, and by CSWA to benchmark sustainable winegrowing practices.

For more information, contact:
SureHarvest, Inc.
2901 Park Ave, Ste A2, Soquel, CA 95076
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California Seed and Plant Lab (Cal-SPL) located near Sacramento (CA), offers plant disease testing and genetic identification of grapevine varieties. The firm was established in 1995 and employs a highly-qualified technical staff (Ph.D. and MS scientists).

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Variety DNA identification: Genetic testing includes fingerprinting of varieties with 8-marker DNA test. Fingerprint is compared with the varietal database (Cal-SPL has all varieties grown in California in the database). Fingerprinting service can also provide genetic profiling for patent applications.

For more information, contact:
California Seed & Plant Lab
7877 Pleasant Grove Rd., Elverta, CA 95626
Parm Randhawa, Ph.D.
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e-mail: randhawa@calspl.com
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TERRA SPĀSE, INC.

Terra Spāse offers state-of-the-art technical solutions to climate- and soil-based problems for existing and new vineyard development projects. Climate data collection, using cutting-edge technologies, is provided to growers by subscription, in real time, for use in vineyard monitoring, integrated pest management, irrigation management, and long-term planning decisions.

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Weather and disease (mildew and botrytis) risk maps for Napa and Sonoma counties are available by subscription at www.terraspase.com. Other Terra Spāse products include vineyard-specific measurements of vine water status and soil moisture status, and NDVI canopy density maps.

The Soil Information System combines electromagnetic conductivity sensors with patented soil physical data collection technology (texture, compaction, AWC) and soil chemical analysis, to create detailed and accurate maps of soil variability. Products include soil Vigor Potential™ maps for vineyard layout, irrigation system design, variety and rootstock selection, soil preparation (ripping depth), and soil amendment applications.

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To meet the needs of vineyards, John Deere introduces three specialty F-Series Orchard/Vineyard tractors. These tractors are specifically designed to operate and maneuver in the confined work environment and field conditions of winegrapes and specialty crops.

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A two-year, 2,000-hour warranty is standard with the F-Series. These tractors are designed to provide years of service to vineyard operators and managers.

For more information, visit www.JohnDeere.com/Ag or contact your local John Deere dealer.

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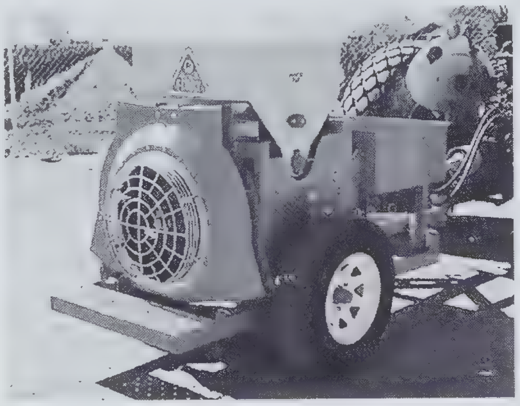
FLORY INDUSTRIES

Flory Industries, a leading agricultural equipment manufacturer since 1936, has engineered the Flory *Pow'r Flo* dusters for sulfur dust application, and the Flory 1000 Series flail mowers for maximum efficiency in vineyard management.



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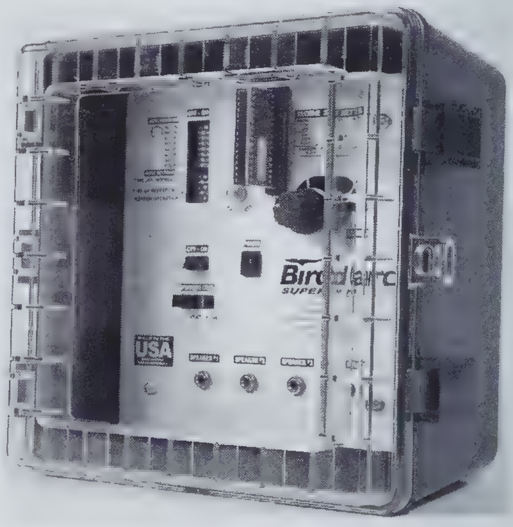

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Pellenc America, Inc. (a Pellenc group subsidiary) made a significant investment in 2007, purchasing a property (Santa Rosa, CA) and upgrading a 28,000 sq. ft. facility that is the North American hub for parts and technical support for Pellenc dealers throughout the U.S. and Canada. Pellenc provides parts, sales, and service (shop and in-field) for Northern California growers from the new store. With considerable change in the industry today, this step further increases Pellenc's ability to serve customers.

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KINSEY AGRICULTURAL SERVICES, INC.

Offers a three-year program of nutrient development, rebuilding the biological aspects of vineyard soils benefiting vine, grape, and wine quality.

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Using detailed measurements formulated from soil analysis data for managing nutrients, it is possible to define, measure, and manage soil fertility. On-site consultations should be utilized to help establish, achieve, and maintain goals in terms of correctly building up natural soil quality options.

Training programs help to clarify soil fertility requirements. Introductory programs for building and maintaining vineyard fertility are posted on the www.kinseyag.com website.

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WINE MICROBIOLOGY *by Robert Tracy*

COMMON SOLUTIONS / UNIQUE ALTERNATIVES

Prevention/management of wine spoilage microorganisms

Throughout all stages of the winemaking process, spoilage microbes can negatively impact wine quality. Wine spoilage can come in the form of off-aromas/off-flavors (acetic acid, ethyl acetate, 4-ethylphenol, 2,4,6-trichloroanisole, and mousiness), cosmetic issues (films, sediment, viscosity, and off-color), bitterness, and formation of compounds that can affect human health (biogenic amines and ethyl carbamate).

Table I shows the wide variety of known bacteria, yeast, and mold genera that have the ability to spoil wine. Included are wine microbes traditionally considered to only contribute positively to wine quality, since their growth at the incorrect stage of winemaking process can lead to spoilage.

The combination of a wide variety of spoilage microbes and the prolonged nature of the winemaking process can make prevention and management of wine microorganisms a complex, difficult, and sometimes costly proposition.

Table I: Wine Spoilage Microorganisms

Microorganism Type	Genera
Bacteria	*Acetobacter, Bacillus, Clostridium, Gluconobacter, Lactobacillus, Leuconostoc, Oenococcus,* and *Pediococcus.*
Yeast	*Brettanomyces, Candida, Hanseniaspora (Kloeckera), Metschnikowia, Pichia, Saccharomyces, Saccharomycodes, Schizosaccharomyces,* and *Zygosaccharomyces.*
Mold	*Aspergillus, Cladosporium, Monilia, Penicillium,* and *Trichoderma.*

When thinking about how to combat wine spoilage, each winery must consider three different approaches and select the one that best fits their circumstances. The most basic approach is to react to a problem that already exists: the spoilage microbes are already present and likely have tainted a wine. This approach generally requires the least upfront cost and time; however, reacting to an issue puts a winery at the greatest risk for poor wine quality and financial loss.

A more advanced tactic is to manage (or control) wine microbes. This approach requires a greater financial and time commitment, but it also minimizes the risk to wine quality.

The most proactive approach is to prevent wine microbes from accessing a wine in the first place. This can be difficult since most of the microbes are part of the natural flora found on grapes and/or in wine, and it usually requires the most significant financial and time obligation. Nevertheless, prevention provides wineries with the best assurance of quality and health safety.

Based on my experience, I would not recommend using a reactive approach since it can leave a winery extremely vulnerable to poor wine quality, financial losses, and production inefficiencies (rework). This column attempts to summarize methods that wineries can use to prevent and manage the detrimental effects wine spoilage microbes can impart to wine. The methods discussed are divided into four categories: sanitation, enological practices, viticultural practices, and wine preservation.

Sanitation

Sanitation is a winery's best strategy to prevent wine spoilage microbes from contaminating grape juice and wine. It is the practice of enhancing product quality and shelf life by suppressing microbial growth (such as mold, yeast, and bacteria) and controlling pests (such as mice, birds, insects, etc.).

Sanitation is different from sterilization, in which the objective is to kill 100% of microorganisms present. In a winery environment, sterilization is not necessary since no human pathogens can grow in wine, and there are times in the winemaking process when microorganisms are essential (such as fermentation).

If sanitation is not implemented properly, debris and wine product will build-up on equipment, which can then serve as sites for the accumulation and subsequent growth of microorganisms.

A successful winery sanitation program involves five factors.

First, it requires a commitment (labor and finances) on the part of all personnel involved with the winemaking process.

Second, it requires several tools: knowledge, standard operating procedures, chemicals, and equipment.

Third, it requires implementing a two-step process:

1) Regular and thorough cleaning of equipment surfaces by removing organic material or debris through scrubbing or spraying in conjunction with a cleaner (caustic cleaner containing NaOH or KOH, trisodium phosphate, sodium percarbonate, phosphoric acid, or foam cleaner); and

2) Once equipment surfaces are visibly clean, use a sanitizer (chlorine dioxide, hot water, iodophors, ozone, peracetic acid, or quaternary ammonium compounds) to reduce the level of living microbial cells. It is critical that a surface be cleaned prior to sanitizing because sanitizers by themselves cannot effectively remove dirt and debris.

Fourth, it involves training winery personnel in the principles and practices of sanitation.

Fifth, it requires an auditing program to verify that sanitation practices are being properly adhered to.

Enological practices

Like sanitation, good winemaking practices are essential to managing and, under ideal circumstances, even preventing proliferation of wine microbes. In order to be most effective, good winemaking practices must be considered and performed as part of an interdependent system and not as individual components; otherwise their effectiveness in minimizing or preventing spoilage microbes will be reduced precipitously.

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Table II: Enological Practices and Necessary Actions to Manage/Prevent Wine Spoilage Microbes

ALCOHOLIC FERMENTATION MANAGEMENT

During alcoholic fermentation, limit contamination risk by:

1) consistently use an optimum yeast inoculation rate (such as 2 lbs/1,000 gallons);

2) control fermentation temperature so it does not get too cold (less than 50°F/10°C for white wines and less than 65°F/18°C for red wines) or too hot (over 65°F/18°C for whites and over 86°F/30°C for reds); and

3) maintain proper nutritional levels (assimilable nitrogen).

ELIMINATE HEAVY LEES

Wines need to be racked from heavy lees (agglomerates of dead yeast and bacteria cells, and tartrate crystals) as soon as possible following fermentation. They are a rich source of nutrients for spoilage microbes and increase binding of sulfur dioxide (SO_2) thus reducing available molecular SO_2 level.

FILTRATION

Filtration is an effective management tool once microbes are known to be present in wine or if winery has a history of a spoilage microbe(s). If spoilage microbes are present, macrofiltration (diatomaceous earth or pad filtration) or microfiltration (cross-flow filtration) is recommended in the cellar, while sterile filtration (membrane filtration with a 0.45 µm pore size) is suggested at bottling to remove all spoilage microbes.

Each winery should identify and implement microbe level specifications (such as more than 100 cfu/ml) to trigger filtration activities. While filtration is an effective insurance policy during winemaking, it continues to be debated as some winemakers argue that it impacts the organoleptic quality of wine.

HUMIDITY CONTROL IN BARREL CELLARS

Maintain high level of humidity (about 80%) to prevent barrels from drying out which reduces possibility of oxygen entering barreled wine.

MACERATION CONTROL

Control length of maceration period because excessive length can lead to increased level of precursors and substrates (such as sugars, amino acids, vitamins, etc) for spoilage microbes.

MAINTAIN TANK AND BARREL HEADSPACE

Whenever possible maintain full tanks and barrels to minimize wine contact with air thus managing aerobic spoilage microbes (such as *Acetobacter*, *Pichia*, or *Brettanomyces*). It is necessary that partially full tanks be blanketed with an inert gas (such as nitrogen or argon).

MAINTAIN PROPER STAFFING LEVELS

Reducing staff below the proper level will lead to inefficient, slow, and poor quality cellar work, which almost invariably leads to wine spoilage.

MALOLACTIC FERMENTATION MANAGEMENT

During malolactic fermentation, minimize contamination risk by:

1) directly inoculate with selected *Oenococcus oeni* strains; and

2) eliminate tank-to-tank spreading of malolactic bacteria.

Eliminate lactic acid bacteria populations immediately following malolactic fermentation by racking wine and adding an appropriate level of SO_2. Once malic acid is consumed, lactic acid bacteria can metabolize other compounds such as sugar or citric acid.

OXYGEN CONTROL

Under aerobic conditions, wine microbes such as *Brettanomyces*, *Acetobacter*, or *Candida* can produce unacceptable levels of acetic acid. It is recommended that dissolved oxygen levels be routinely monitored in the cellar and maintained below 1.0 mg/L in cellared wines and 0.40 mg/L in bottled wines.

pH CONTROL

A wine pH under 3.6 makes growth conditions less favorable for wine microbes. Besides favoring microbial growth, raised pH levels (above 3.6) increase the amount of bound SO_2 which, in turn, reduces the amount of microbiologically-active molecular SO_2.

ROUTINE TOPPING OF BARRELS

It is critical that topping of barrels be routinely scheduled (such as once every four to six weeks) to prevent headspace formation. Barrel headspace creates an opportunity for aerobic microbes to grow due to air filling the empty space.

TEMPERATURE CONTROL OF WINE

Following completion of malolactic fermentation (or completion of alcoholic fermentation for selected whites and Rosés), place wines in an environment with a temperature less than 60°F (16°C).

Table II shows many of the critical enological practices that need to be performed during the life of a wine and the required actions to minimize and even prevent spoilage microbe propagation.

Viticultural practices

Important factors in the prevention and management of wine microbes are grape quality in the vineyards, how the grapes are transported to the winery, and handling on arrival. It is highly recommended that grapes coming into a winery have minimal damage and *Botrytis cinerea* infections. There is a high probability that damaged and *Botrytis*-infected grapes will have an elevated level of wine spoilage microbes (such as *Acetobacter*).

Grapes transported to a winery need to be kept cool to slow microbial growth. After grapes have arrived at the winery, an SO_2 addition (about 50 ppm) at the crush stage will reduce microbe populations.

Wine preservation

Due to the potential for the widespread presence of wine spoilage microbes during all stages of the winemaking process, it is critical that wineries have procedures in place to ensure the microbiological stability of their wines. If methods to prevent spoilage microbes from entering the winemaking process (sanitation, preventing damage to grapes, and good enological practices) are unsuccessful, then winemakers must rely on ways to manage microorganisms once they are in a wine by inactivating or slowing their growth.

Today, wineries have the ability to manage microbes using chemical and/or biological preservatives including traditional methods and alternative approaches. The development of alternative methods is being driven by consumer demand for more environmentally-friendly and healthier preservatives.

Traditional chemical preservatives include SO_2 and dimethyl dicarbonate (trade name Velcorin™). SO_2 is an effective antimicrobial and antioxidative agent with a long history of use in winemaking. The U.S. legal limit for SO_2 in wines is currently 350 ppm, total. Wineries must disclose, on their label, if greater than 10 ppm total SO_2 is present.

In an aqueous solution, SO_2 can exist in three different forms with the equilibrium between the three forms being pH-dependent: molecular SO_2 (SO_2 H_2O), bisulfite ion (HSO_3^-), or sulfite ion (SO_3^{2-}). Molecular SO_2 is the only form with antimicrobial activity and its activity increases with decreasing pH.[1,2,3]

During the winemaking process, the molecular SO_2 level should be maintained between 0.4 to 0.8 ppm depending on the wine. The antimicrobial activity of SO_2 can diminish as a result of: 1) increased pH and/or, 2) getting "bound" to carbon-containing compounds (sugars, pyruvic acid, acetaldehyde, anthocyanins, etc.).[3,4,5]

The inhibitory action of SO_2 is manifest in its ability to react with cofactors (NAD+) required for enzymatic reactions, to react with adenosine triphosphate (ATP), and to disrupt disulfide bridges in proteins. Due to its toxicity, the allergic responses it can cause in humans, its complex chemistry, and the negative impact that it can have on wine quality, there is an increased interest in finding more favorable alternatives.

Dimethyl dicarbonate (DMDC) is an effective antimicrobial agent against wine microbes. It can be lethal to both yeast and bacteria, although, in general, higher concentrations of DMDC are required to kill bacteria.[6] It has been approved to be used in wine at a maximum concentration of 200 ppm during the life of the wine.

The DMDC mechanism of action is to denature enzymes (alcohol dehydrogenase and glyceraldehyde-3-phosphate dehydrogenase) that function in the fermentative pathway.[7] Concerns associated with its use include: 1) low solubility in water, so it must be thoroughly mixed in wine; 2) expensive dosing equipment; and 3) proper safety precautions, which must be used when handling DMDC since it can pose a safety risk.

An alternative chemical preservative that has been researched for possible use in wine is carbon monoxide.[8] Although it has not been used in practice, research has shown that it can control several wine spoilage yeasts including *Brettanomyces*, *Kloeckera*, and *Zygosaccharomyces*, at concentrations ranging from 90 to 480 ppm. Although it is less toxic than SO_2, concerns exist regarding its use since it requires specialized equipment to detect its presence.

Concerns regarding the toxicity and poor environmental impact of chemical preservatives have led wine industry researchers to start exploiting biological systems (such as microbes, plants, and animals) in an attempt to find healthier and more natural antimicrobial agents for wine.

A biological preservative being used in wine is lysozyme. Lysozyme is an enzyme derived from egg whites and is very active against Gram-positive bacteria found in wine (such as *Lactobacillus*, *Pediococcus*, and *Oenococcus*). It has little or no activity against Gram-negative bacteria (Acetobacter) and has no effect on yeast or mold.

Advantages of using lysozyme are that it is organoleptically neutral, poses no risk to human health, and its antimicrobial activity increases with increasing pH.[9,10] Its use is complicated by the fact that: 1) different concentrations are required at distinct stages of the winemaking process; 2) lactic acid bacteria have varying sensitivities; and 3) its activity is higher in white wines compared to red wines due to the increased content of phenolic compounds in red wines.[10,11]

Other biological antimicrobial agents not yet approved for use in wine, but being investigated as possible alternatives, include bacteriocins, zymocins, and plant extracts. Bacteriocins are antimicrobial peptides synthesized primarily by the ribosomes of lactic acid bacteria that inhibit closely related bacteria (see duToit and Pretorius[4]). They are nontoxic, odorless, and colorless.

Examples of bacteriocins include nisin, pediocin, and leucocin. Nisin has been successfully tested in wine to inhibit the growth of lactic acid bacteria.[12,13]

Zymocins are extracellular peptide toxins (killer toxins) produced by some yeast that can kill other sensitive yeast.

Plant extracts are a potential, effective inhibitor of microbes in wine. For example, the extract of paprika seeds has been shown to be lethal to *Saccharomyces cerevisiae* during alcoholic fermentation.[14]

The limitation to implementing the use of these biological preservatives in the wine industry is the cost of research and development.

Summary

A multi-faceted approach is required to properly manage and prevent the proliferation of wine spoilage microorganisms in juice and wine. It requires a combination of good sanitation practices, good winemaking practices, using sound grapes, and

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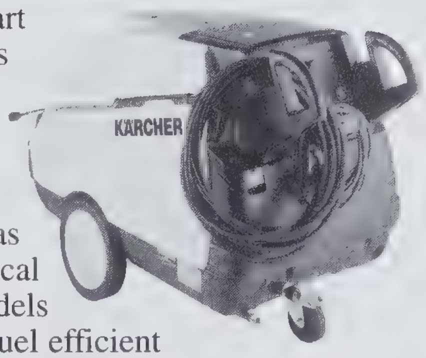

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properly managing spoilage microbes with chemical or biological preservatives if prevention is unsuccessful. ■

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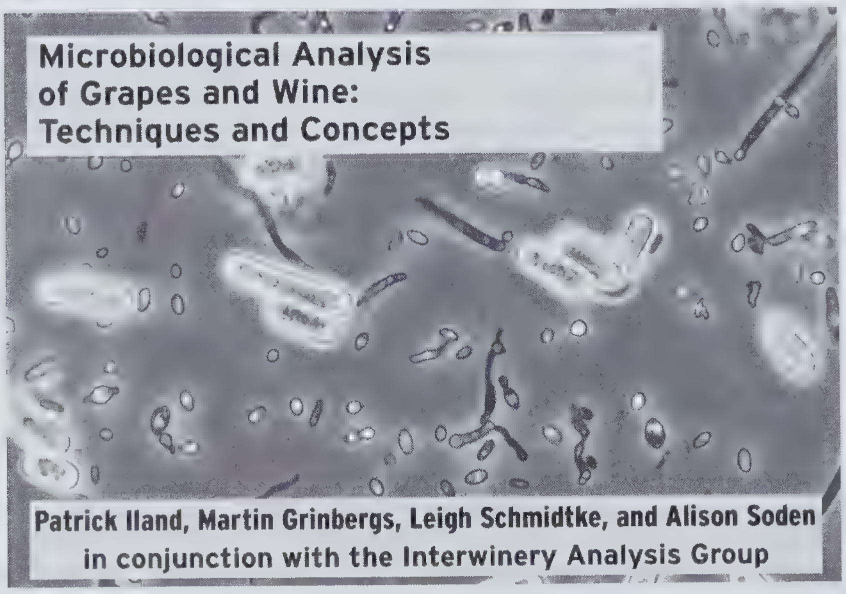

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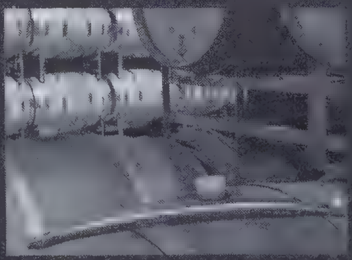

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G3 Enterprises adds mobile bottling to its growing portfolio of products and services. "Mobile bottling was a natural extension to our current product offerings," explains Charles Pierce, general manager of Mobile Bottling. "We have been a 'one stop shop' for wine packaging, and now we can also bottle our customers' wine."

The new 53-foot long mobile bottling truck has a 24-head, 4D, gravity-fed filler and a six-head Bertolaso Delta-R automatic, revolving, vacuum-corker, capable of filling up to 4,000 cases per eight-hour day, that serves the entire state of California. Customers can choose from all or specific bottling services including:

- bottle cleaning/sparging,
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- palletizing.

With an emphasis on quality, value, and service, the G3 main focus of their new line is to pay attention to and provide documentation of sanitation and oxygen levels.

Headquartered in Modesto, CA, G3 Enterprises has been supplying the wine industry for over 46 years. As a single-source packaging solution for wineries, their products and services include screwcaps, labels, capsules, warehousing, transportation, technical services, and bottle decorating.

For more information on G3's Mobile Bottling, please contact John Farley at 209/341-7340 or email (john.farley@g3enterprises.com). For information on other G3 products and services, please contact Kimberly Jussely at 209/341-6813 or kimberly.jussely@g3enterprises.com. ■

ZORK USA partners with bottlers

ZORK USA has signed Pickering Winery Supply to sell and distribute the ZORK closure to wineries throughout California, Washington, and Oregon.

ZORK USA has partnered with three California bottlers to provide local wineries a convenient opportunity to bottle their wines using the ZORK closure. Invitations have gone out to wineries in northern California, the Central Coast, and Temecula.

Sonoma Wine Co. serves the Napa/Sonoma region with three bottling lines, including one that has been outfitted for ZORK application.

Top It Off Bottling, which serves northern California as far north as Oregon, has four mobile bottling trucks and one dedicated ZORK line.

Castoro Bottling Company has four mobile trucks and is equipped to bottle with ZORK.

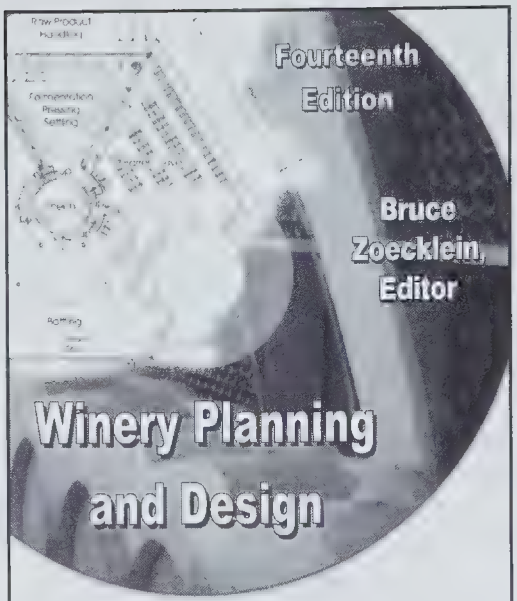
"Wineries throughout California now have ready access to a bottler that's set up for ZORK," says Robert Morey, ZORK USA director of sales. "We're making it very convenient for a trial or for a production run, large or small."

The ZORK closure consists of three parts: an outer, tamper-evident cap; an inner metal foil oxygen barrier; and a plunger that "pops" like a cork when extracted and is easily reinserted.

While ZORK's official launch is slated for 2008, Don Sebastiani & Sons uses ZORK for several of its brands. Several other California and Washington wineries have also released wines under ZORK.

ZORK USA is a division of Portola Packaging, Inc., a U.S.-based global designer, manufacturer, and marketer of recyclable plastic closures, bottles, and related equipment and tooling used for packaging beverages.

Wineries can call ZORK USA at 866-996-ZORK (9675) x2077 for more information. ■



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COMPLIANCE COUNSELING

by Rachel Dumas Rey

Preparing for a TTB visit

Notice of an Alcohol and Tobacco Tax and Trade Bureau (TTB) audit can strike fear into the hearts of many winery operators. For most though, an audit will be little more than a temporary inconvenience. In the wine world, there are two types of federal audits, a revenue audit and a product integrity audit.

Revenue audits

In 2001, the Department of Treasury's TTB created a new Tax Audit Division (TAD) to ensure that the government is collecting its legal share of your hard-earned money. The 10 TAD offices focus on the largest producers and taxpayers and those with a history of non-compliance, although random audits are also conducted.

Non-filing and late filing of tax returns or Monthly Reports of Wine Premises Operations (702s) can increase your risk of being audited by the TAD. Small and medium-size wineries will typically receive a call from the Wine Tax Unit at TTB's National Revenue Center (NRC) if there is a problem or error with a tax return. Often those issues can be resolved with a short phone conversation.

If the winery operator is not responsive to a call from the NRC or if larger concerns have been uncovered, an extensive revenue audit may be the next step.

Typically, a targeted winery will receive 30 days notice from the TAD prior to the start of a revenue audit. Wineries can expect three to five auditors to spend two to three weeks reviewing up to three years worth of activity.

According to the TTB website (www.ttb.gov), "A full-scope audit includes looking not only at tax returns and monthly reports but also examining the company for compliance with the appropriate sections of the Code of Federal Regulations. TTB auditors also examine internal controls as they relate to the preparation of operating reports and tax returns.

A full-scope audit includes examination of many areas of a taxpayer's records, including general ledgers, inventory and production systems, and automated data processing, as they relate to compliance with Federal laws and regulations."

Product integrity investigations

The TTB's Trade Investigations Division (TID) has 80 field supervisors and investigators responsible for overseeing TTB's application, product integrity, consumer complaint, and trade practice investigations.

Product integrity investigations from the TID may be the result of consumer or industry complaints, anonymous tips, or information passed down from other TTB staff at the National Revenue Center. These audits are very rarely random and advance notice is not always given.

The TID's primary goal in a product integrity audit is to ensure that your label claims can be verified through source documents, such as grape delivery tickets, weigh tags, alcohol tests, and financial records. They will focus on your available inventory, and like the TAD, the TID investigators may want to see three years worth of records.

The length of the audit can depend on many factors, including the number of products being reviewed, and if problems arise, they may look at more products.

These audits may seem daunting, but there are a few easy steps winery managers can take to make the TTB audit process smoother.

Conduct your own audit

First, whether you are being audited or not, you should audit yourself or hire a compliance professional to conduct an internal audit of your records every couple of years. If you catch your own errors first and take steps to remedy those mistakes, you may be able to avoid a visit from TTB or to negotiate relief from administrative penalties resulting from a TTB audit.

Your internal audit should include a thorough review of your inventory reports and tax returns. You should also review your original application for a Federal Basic Permit and any recent amendments to be sure that your winery description is still accurate and that you are not operating outside of your designated bonded space. It is also important to check your bond coverage and increase it if it is not adequate.

Conduct multiple alcohol tests

Second, it is also a good idea to conduct more than one alcohol test during the winemaking process and prior to printing a label. If your percent alcohol by volume is near the threshold of 14%, it is a good idea to send your wine to a TTB-approved lab for testing, so you have assurances that your wine is labeled with the correct alcohol in the correct tax class. If your winery lab test is 14% and a TTB auditors test is higher, you will have to pay the additional principal tax and penalties and interest regardless of earlier test results.

Take physical inventory every month

It is critical to take a physical inventory each month in your winery. Even if you are only reporting your inventory to TTB quarterly or annually, a monthly count will help ensure that your records are up-to-date and your reports are accurate. A written procedure for taking inventory is important for non-owner-operated wineries and provides for consistency in the event of staff-turnover.

Maintain supporting documents in chronological order

It is critical to maintain clear **and complete** supporting documents for all entries on your Monthly Report of Wine Premises Operations (702). Revenue auditors will ask to review all your 702s and tax returns for the audit period and to substantiate all of your entries.

It has been my experience that winery managers do a good job with record retention but need help organizing the information. The simplest way to manage your records is chronologically and all in one place. Most winery staff will file weigh tags separately from bills of lading and tax returns in yet another completely separate file.

If you want to get your TTB audit completed quickly and efficiently, you should create a file for each month of the year. Each file should include a physical inventory and a signed copy of your 702. Every entry on the 702 should have a source document to back up the entry.

For example, if you bottled during the month, you should have a federal label approval, an alcohol test, and a bottling record showing what you bottled and gallons lost in the bottling process.

If you removed wine from bond, you should have a bill of lading showing where it went. If you paid taxes on that wine, you should have a corresponding tax return and a copy of your check. If you are audited, this filing strategy will allow the TTB personnel to move through your records quickly with little **disruption to your business.**

Communicate with TTB staff directly

TTB holds annual training for wineries in all major wine regions at no charge to you. You can also call TTB staff directly with questions ranging from how to complete a tax return to more technical questions about regulations and the winemaking process.

At the conclusion of any audit or investigation, TTB staff will provide the subject winery with a complete report of their findings. It is important to respond to that report in writing and to address any violations that have been uncovered.

A written response describing specific actions you are taking to right any wrongs now should be included (such as paying back taxes, interest and penalties). How you plan to avoid future violations should also be part of your response.

Creating standard operating procedures to deal with problem areas is a great step. Another positive response is to commit to on-going regulatory training for all winery personnel, either through TTB seminars or other means.

Following through on those commitments is important for those with serious violations because TTB will return to visit again and again until your operation is fully compliant. Part of the mission of both TTB divisions is to promote voluntary compliance, and your active participation in that process will be considered in determining any punitive action or exacting of monetary penalties for violations uncovered in an audit or investigations of your winery. ■

Rachel Dumas Rey is president of Compli, a full service beverage compliance firm in Paso Robles, CA. Prior to establishing Compli in 1997, she worked for the U.S. Department of Commerce's Export Administration in Washington D.C.

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Syrah red leaf disorder

Continued from page 45

Central Coast vineyards. I have, however, seen a few vines in the Central Coast with similar symptoms to "Shiraz decline."

I think that the second condition, called "Shiraz disease," has symptoms, in my opinion, more like the common Californian problem. In particular, shoots fail to lignify in the fall and are "rubbery," which has been shown in South Africa to be due to lack of secondary xylem and phloem development. This disease is associated with the viti virus GVA and is known to be spread by mealy bugs. It has also been described in Australia.

I was surprised that the local research did not include any studies of spread, or that these studies had not been done. I was further surprised that there were not more practical suggestions to growers. Why not, for example, in a new vineyard with only a few symptomatic plants, remove them as soon as the symptoms are seen?

Conclusion

Thank goodness that Syrah red leaf disorder may now get the attention it deserves, but it may be 10 years too late. My observations indicate that the problem is quite widespread, at least in the Central Coast. Let us hope that the contributing factors and management control strategies (for the vines and/or the vector?) are soon identified.

There are key questions to be answered by the research, including:

How widespread is the problem?

Can different disorders be identified by symptomology and pathogen testing?

Is it (are they) spread by propagation?

What are the pathogens and vectors?

Which factors currently limit the distribution and occurrence?

How might vineyards be managed to reduce spread and to minimize impacts?

How many varieties are sensitive to the disorder?

If I were handing out research funds, I would give this issue high priority. In the meantime, thanks to Mark and Rhonda for raising the profile of the problem. ■

Dr. Richard Smart, "the flying vinedoctor," is an international viticultural consultant based in Launceston, Tasmania, in Australia. He can be contacted by e-mail: vinedoc@bigpond.net.au. Read about Dr. Smart's business, including his consulting schedule, educational wine tours, and seminars, at his home page http://www.smartvit.com.au. He visits America frequently and his consulting schedule is arranged by Vinquiry in Windsor, CA, tel: 707/ 838-6312 and http://www.vinquiry.com.

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Personnel Perspective	63	707-576-7653	707-576-8190	info@personnelperspective.com
Pickering Winery Supply	62	415-474-1588	415-474-1617	pickering@sbcglobal.net
Plantra	36	800-518-6872	805-462-1378	steve@plantra.com
Premiere Viticulture	36	707-261-8750		premierevit.com
Ramondin USA	3	707-499-2277	707-257-1408	ramondinusa@ramondinusa.com
Raymond Vineyards	64	707-963-3141		customcrush@raymondvineyards.com
Rivercap	23	707-747-3630	707-746-7471	sales@rivercapusa.com
Roberts & Son Cooperage	53	415-457-3955	415-457-0304	staff@boswellcompany.com
St. Patrick's of Texas	28	512-989-9727	512-989-8982	stpats@bga.com
Scott Laboratories	12	707-765-6666	707-765-6674	info@scottlabs.com
Shur Farms Frost Protection	49	877-842-9688	909-825-2611	shurfarms@earthlink.net
Sonoma Cty Winegrape Com.	91	707-522-5860		sonomawinegrape.org
Spec Trellising	52	800-237-4594	215-357-3122	info@spectrellising.com
Spectrum Technologies	49	800-248-8873	815-436-4460	specmeters.com
Sunridge Nurseries	15	661-363-VINE	661-366-4251	sunridgenurseries.com
SureHarvest	21	831-477-7797	831-477-7790	sales@sureharvest.com
Terravant Wine Co.	34	805-686-9400		terravant.com
Terra Spase	24	707-967-8323	707-967-8596	info@terraspase.com
Tonnellerie Bel Air	63	707-965-2119	707-965-2923	ac@arminee.com
Tonnellerie Boutes	43	510-799-1518	510-799-1557	boutesusa@sbcglobal.com
Tonnellerie Quintessence	10	707-935-3452	707-935-3422	tonnelleriequintessence.com
Tonnellerie Saury USA	30	707-944-1330	707-944-1370	info@sauryusa.com
Tonnellerie Sirugue	65	310-452-8147	310-452-7847	sirugueusa@earthlink.net
T.W. Boswell	39	707-255-5900	707-255-5952	info@twboswell.com
Turrentine Brokerage	33	415-209-9463	415-209-0079	turrentinebrokerage.com
Vinquiry	12	707-838-6321	707-838-1765	info@vinquiry.com
Vintage Nurseries	25	800-499-9019	805-758-4999	vintagenurseries.com
Weedbadger	22	800-437-3392	701-778-7501	info@weedbadger.com
Westec Tank/ Belli Corp.	27	707-431-9342	707-431-8809	joe@westectank.com
Western Square Industries	14	800-367-8383	209-944-0934	westernsquare.com
The Winegrowing Consortium	55	888-897-3030		winegrowingconsortium.com
World Cooperage	92	707-255-5900	707-255-5952	info@worldcooperage.com

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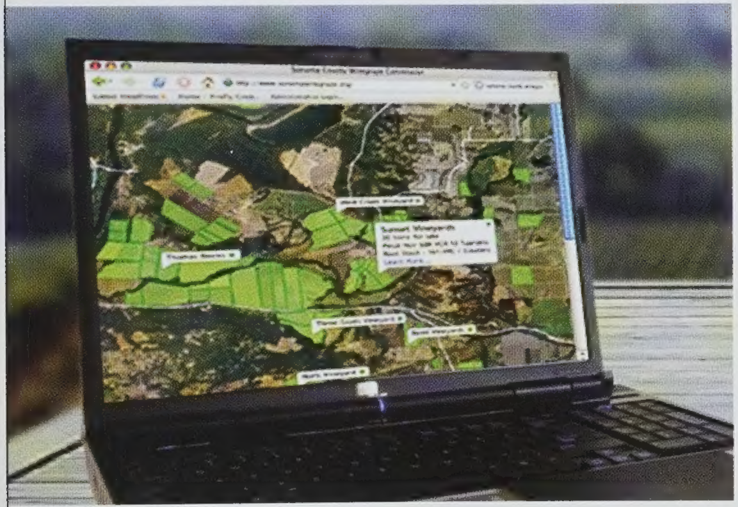

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- WELL-STRUCTURED BARREL HIGHLIGHTS SWEET RASPBERRY FLAVORS
- PRESERVES THE SUPPLE RED FRUIT
- DELICATE TANNINS + CREAMY OAK BROADEN MOUTHFEEL

AARON PIOTTER
Winemaker
Ferrari-Carano

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